HEAT AND VENTILATION.

GENERAL OBSERVATIONS

ON THE

ATMOSPHERE AND ITS ABUSES,

AS CONNECTED WITH THE COMMON OR POPULAR

MODE OF HEATING PUBLIC AND PRIVATE DWELLINGS,

TOGETHER WITH

PRACTICAL SUGGESTIONS UPON THE BEST MODE OF WARMING AND VENTILATING, AS DEVELOPED BY RECENT INVESTIGATION AND IMPROVEMENTS.

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PREFACE.

Some four years since, the writer of the following pages had his attention repeatedly called to the subject of Ventilation, as one of great practical importance, but most singularly neglected. Circumstances subsequently induced him to examine the matter with considerable care, and the result left a deep and lasting impression upon his mind. The present mode of heating buildings, and the entire inattention to the abuses of the atmosphere, so common in nearly every private dwelling and public building, is a striking illustration of the strides society will often make in passing from one extreme to another. In shutting up the old fashioned chimney, and introducing the close stove, we have nearly closed every avenue for fresh air, and with it there has been a great increase of consumption, scrofula, and physical degeneracy. "However parodoxical it may appear," says Count Runiford, "there is nothing more difficult than to prevail on the public to accept the boon of improvement, even in matters which come home to every man's business and bosom." The distribution of heat, and a wholesome atmosphere, in our dwellings, interests all classes and conditions of society. In our suggestions we have endeavored to point out some of the consequences of inattention to Ventilation, and most objectionable modes of heating our houses. We have avoided all technicalities, and equivocal positions, and regret that our illustrations from engraved figures are so meagre. When first proposing to commit our views to paper, we engaged a talented and promising young artist (a son of the late J. L. D. Mathies,) who proceeded to New York with quite a large number of sketches, and when his task was nearly completed, he was attacked with a fatal disease. Having never been able to find either the plates or drawings, we have proceeded without them, and considerably contracted what we at first proposed. Soon after the manuscript was put into the publisher's hands, we were obliged to leave town for a short time, and upon our return, found the type had been set and distributed. This will account for several very provoking errors in punctuation, with an occasional misprint, which in some instances conveys an impression entirely different from that which was intended. If, however, these hasty suggestions have the effect of awakening attention to a subject which we deem to be of vast importance to the health and happiness of the whole community, our object will have been fully attained.

HEAT AND VENTILATION.

PART I.

General Observations with regard to the Atmosphere and its Abuse, in Private and Public Buildings.

In order to appreciate the necessity of ventilation, we must first understand the properties of the atmosphere and some of the changes it undergoes. As it is our object to point out a method, by which public and private buildings can be furnished with a constant supply of pure air, and remove that which has been injured by respiration or otherwise, it is important that we should not only understand in what its purity consists, but by what means its purity can be preserved. The atmosphere in its natural state is composed of three gases—Oxygen, Nitrogen, and Carbonic Acid. There is still a difference of opinion among chemists as to the *exact* proportion in which these separate gases are combined, but it is sufficient for all practical purposes to take the analysis which is most generally received, viz: that every 100 parts of the atmosphere is composed of 21 parts of oxygen, 78 of nitrogen, and 1 of carbonic acid. The air is very compressible and elastic. It can be diminished in volume by pressure, or increased by diminishing the pressure. Its specific weight has been accurately ascertained, and found to press or bear upon all substances at the rate of 15 lbs. on every square inch of surface. A moment's reflection will convince any one of the important agency performed by atmospheric air in the whole economy of nature. It is absolutely essential to animal and vegetable life, and although it is undergoing constant changes, which unfit it for the support of animal life, its natural reorganization into a state of perfect purity, is one of the most beautiful illustrations of the wisdom and goodness of the Creator.

It has been ascertained by separating the gases, composing the atmosphere, that oxygen is the supporter of combustion and animal life. Nitrogen and carbonic acid will support neither. Any increase or diminution of oxygen in the atmosphere is injurious to health. An excess overacts, and produces fever, inflammation, &c. &e. A deficiency produces languor, debility, and finally, complete exhaustion. Although human life is entirely dependant upon oxygen, it must be diluted by nitrogen, as found in the natural state of the atmosphere, to be at all suited to the animal economy, or meet the demands of our physical organization. Carbonic acid which constitutes about 1 per cent. of the atmosphere (some writers make it much less), is, when in its pure state, one of the most deadly poisons known to the chemist. Four per cent. of this gas in the atmosphere, will extinguish a lighted taper; and 10 per cent. will destroy animal life almost instantly. A lesser quantity will produce pain in the head, congestion of the brain, fainting, drowsiness, and an entire indisposition to exercise of any sort. Whenever the air has been once respired, it is deprived of about 6 per cent. of its oxygen, and its place is filled with carbonic acid and vapor. If the expired air should be collected in a vessel, it would be found to contain from 3 to 4 per cent. of carbonic acid; a sufficient quantity to extinguish a burning lamp, according to late experiments; the average number of respirations made by a healthy adult, is 20 per minute., and the average bulk of air respired from each inspiration, is 16 cubic inches. Carbonic acid gas is about one and a half times as heavy as atmospheric air, and can be poured from one vessel to another. This gas when mixed with water, makes a healthful and invigorating drink; but if taken into the lungs, produces almost instantaneous death. It is always produced in burning charcoal, and hence the danger of placing pans of hot coals in sleeping apartments, or in any room imperfectly ventilated. This fact has been so often published to the world, and the horrible consequences of this practice so frequently narrated, it is surprising that an individual can be found in ignorance of the fact.

A great variety of causes are in constant operation to produce carbonic acid. It is evolved in great quantities from ordinary combustion and the respiration of men and animals; but He who regulates all things, uses that which is poisonous to man for the support of the vegetable kingdom. There is another law equally important in restoring the atmosphere. It is the affinity which all gases have for

each other. The discovery of this law is of the first importance in establishing the principles of ventilation. Mr. Dalton has demonstrated, by a great variety of experiments, that æriform bodies possess the property of diffusing themselves through each other's masses to an unlimited extent. As before stated, carbonic acid is 1½ times as heavy as atmospheric air, and according to the law of gravity, it would always fall to the earth, or to the floor of a room, and there continue to accumulate, if it were not for the law of diffusion. Mr. Dalton filled two cylinderical vessels — the one with carbonic acid and the other with hydrogen. The latter was placed perpendicularly over the former and the two connected by means of a small tube two or three feet long. In a few hours these gases were found perfectly and equally mixed. Carbonic acid is some 20 times heavier than hydrogen. A great number of similar experiments might be named, which prove beyond all contradiction, that the diffusion or spontaneous intermixture of gases, coming in contact with each other, is as well established as the fact that vegetation absorbs carbonic acid and eleminates oxygen. This law of the diffusion of gases connected with the important fact, that respired air is some 5 per cent. lighter than the surrounding atmosphere at 65 deg. Fah. makes it easy to dispose of all that is offensive or injurious, arising from respiration or the exhalations of the body. But notwithstanding these well established principles we have, within the last year, seen gentlemen of great intelligence in other matters, providing ventilating flues at the *bottom of the room*, and assigning as a reason for this mode or plan, that the specific gravity of carbonic acid caused it to fall to the floor. Indeed a popular writer of late date, whose work has received the most marked commendation, proposes to take the carbonic acid from the bottom of the room to support *the combustion going on in the furnace.*

When we take into consideration the importance of ventilation, and how strangely the whole subject has been overlooked by the most intelligent portion of the community, we need not be surprised at the disease and death so often produced by a poisonous atmosphere.

A. J. Downing, Esq., who has done so much by his pen to improve the taste of our people in architecture, and increase the comforts and attachments of home, very properly says, "as a people we still know nothing about ventilation." One has only to travel in our crowded steamboats where three hundred persons are content to lie down like

cattle, in the stifled atmosphere of a warm cabin, which as a sleeping apartment would contain wholesome air enough for barely a dozen people; or our rail-roads in winter, when thirty or forty people thrust themselves into a car, with a fiery little salamander burning up what little oxygen may remain in the atmosphere after being continually breathed over; or be a victim in that worst of all places, a lecture room, or concert room, or church, where some extraordinary attraction has drawn a "full house" — to know that the sovereign people, who *have* learned something of the value of *pure water*, so as to pay cheerfully millions for Croton or Schuylkill, have not yet been brought to acknowledge the *indispensable* necessity of pure air. It is certainly one of the most important of the "rural arts" to know how to build a dwelling-house so as to attain the maximum of health and comfort within its walls. "But," he continues, "the ignorance on this subject (ventilation) is deplorable."

In the construction of our houses a refined taste is often displayed, and everything is constructed in the most substantial manner. In this climate great care is taken to shut out every particle of air, with a view of keeping perfectly warm during the winter months. Not a single suggestion has been made by the architect or builder, relating to ventilation, and the proprietor of the establishment often prides himself upon the fact, that he has the warmest house in town. His windows are perhaps double, every crevice is closed, and the bleak winds of winter are effectually shut out. Let such a house be heated, as is often the case, by one of Dr. Nott's fuel-saving stoves, and we venture to assert, a more unwholesome establishment can seldom be found.

After the air has been once used in respiration, it is as unfit for imparting strength and vigor to the constitution, as food which has been once digested. We use food three times during the twenty-four hours, and require water about as often; but the air we breathe is constantly at our lips, and we cannot live a moment without its introduction into our lungs, and if rendered impure by our own inattention or ignorance, the whole constitution must soon feel its effects.

The circulation of the blood through the body is designed to distribute the nourishment which it receives from the digested food, to all parts of our organization. It starts from the heart, and goes to the extremities — returns to the lungs loaded with carbon which has been rejected by the animal tissues, as unfit for their growth and pre-

servation. When it arrives at the air cells of the lungs, this accumulation of carbon combines with the oxygen of the atmosphere, and is thrown off in the form of carbonic acid gas. This operation is performed and repeated 20 times per minute and 16 cubic inches of air used at each respiration. In order to prevent any portion of the air from being inhaled a second time, it has been estimated by good authority, that each individual should be allowed eight cubic feet of air per minute. In a room sixteen feet square with ten feet ceilings, ten persons will, according to this allowance, use all the air of the room once in thirty-two minutes. In a close room with an Olmstead or any other kind of "tight-air" stove, and perhaps a large astral lamp to assist in consuming the oxygen of the atmosphere, what a luxury such a room with double windows, "perfectly tight," must be in a cold winter's night! Need we wonder that when such an atmosphere re-enters, the cavity of the lungs, loaded with carbon which it has thrice rejected, but which must again take the circuit of the circulation, and deposit its poisonous qualities in the most exposed parts of the constitution, should produce rheumatism, fever, and a thousand other ills, which "flesh is heir to."

Bernan, an English writer upon this subject, says: "It should never be overlooked that, by breathing pent up effete air, all the advantages of an abundance of fuel and every blessing of a genial sky are utterly thrown away; and though the habitation were on the hill-top, favored by the sweetest breezes of heaven, it would become the focus of contagious and loathsome disease and of death in its most appalling aspect. On the other hand even in the confined quarters of a crowded city rife in malaria, and when pestilence is striking whole families and classes, ventilation and warmth, with cleanliness their usual attendant, like the sprinklings on the lintels and door-posts of the Hebrew dwellings, stand as a sign to the destroying angel, as he passes over, to stay his hand, for, in the warm, fresh-aired chamber, none may be smitten."

Nothing is more common among our people than the practice of sleeping in cold chambers for the purpose, as they suppose, of having fresh air. If, during the day or a part of the day, the windows have been raised at the bottom and lowered at the top, the *probability* is —the room contains pure air; but if the *top* of the window is some distance below the ceiling (as is often the case in the cottage style of building,) the ventilation must be quite partial. If one desires to

satisfy himself on this point, let him burn a small quantity of powder in a room with low windows, and then raise them in the ordinary mode of "airing," and observe the time required in ejecting *all* that is in the bed room, and introducing fresh air in its place. If there are windows only on one side of the room, it is almost impossible to change the air. Air is none the more wholesome for being *cold*, and the practice of going from warm rooms, in a state of perspiration, to a bed room perfectly cold, when all the clothing must be removed—the perspiration suddenly checked, and the whole body chilled—is often as injurious to health as it is disagreeable to the feelings. But let us suppose the sleeping chamber to have been thoroughly aired during the day, and the air perfectly pure, when we enter it for the night. A room 16 feet square with 10 feet ceiling, would contain 2,560 feet of air. Place two in this room, and allow eight cubic feet per minute to each, and the whole will have been used in less than three hours. But when we refer to the fact that the expired gas is soon diffused throughout the whole atmosphere of the room, we need not wait three nor two hours to discover the effect; nor need we wonder at the dryness of the tongue, feverish taste in the mouth, or disagreeable odor which is so apparent upon entering a close room of the size alluded to, in the morning after being occupied one night by two persons. If the air is offensive and unwholesome under such circumstances, what must it be, when heated by a close stove, or candle kept burning—(a candle will consume as much oxygen as one individual)—and a child lying sick, in the same room, with measles, scarlet fever, putrid sore throat, or incipient consumption! Need we wonder, when there is added to such effete air, the poisonous exhalations of a diseased skin, or mucous membrane, that scarlet fever runs through whole families, while perhaps no one else in the neighborhood is affected; or, is it strange that consumption still lingers in a family after the first one affected has been taken away? But if, on the other hand, our living and sleeping apartments were properly ventilated, and the entire air of the room expelled, and fresh pure air introduced in its stead every fifteen or twenty minutes, the exhalations of scarlet fever, putrid sore throat, and similar diseases, would generally pass off with the foul air, without affecting those who are obliged to attend upon them.

It is the opinion of some of the best medical writers that most contagious diseases are communicated through the atmosphere, and it

requires but a moment's reflection to perceive, that a *confined* pestilential atmosphere must operate with increased power upon all who are susceptible to the virus. There are other causes about most of our dwelling-houses in operation, which greatly injure the atmosphere. In the cellar even when perfectly dry, there is often more or less vegetable decomposition, and not one cellar in a thousand is provided with any plan of ventilation, except an occasional open window. If the weather is cold and fresh air is admitted, it falls from its own specific gravity to the bottom, and the exhalations from decayed vegetation are forced up through the crevices around the stairway into the upper part of the house. Many establishments have underground kitchens, and for the purpose of keeping everything in fine order above stairs, do all their cooking with a cook stove. Most of the exhalations from broiled meats, vegetables, and the boiling and stewing, are sent above, as if to notify the family of what was preparing for their delicate stomachs, and *practically* to *inhale*, what might, under other circumstances, be a total loss.

Dr. Backus, one of the most reputable and intelligent physicians in this section of the country, stated in his lecture on public health a few months since, some startling statistics relating to the diseases among children. In New Orleans and Chicago, the land is so low that it is impracticable to use underground cellars, and while these two cities are considered among the most unhealthy in the Union, the rate of mortality, among children under five years of age, is a very large per centage less than in any other city in the country. From this he drew the inference that the decayed vegetation, dampness, and *cooking* of underground cellars, contributed very largely to the cause of mortality which swept such a large number of infants to an untimely grave. He was *particularly* and, we think, justly severe upon the "cellar kitchens," particularly in a town like ours, where the dimensions of our lots are abundantly large to allow us to cook and eat above ground. If *necessity* or *taste* compels any one to do their cooking in the basement, we would advise them to throw out the cooking stove, and introduce the cooking range. If properly constructed, they are as easily managed as the stove; and if set as they should be, all the noxious gases and offensive odors are carried directly up the chimney, and none are allowed to escape even into the kitchen, much less in the rooms above. It is not a little surprising in a town like ours, where so much taste is shown in the internal arrangements as

well as in the external embellishments of our houses and grounds, that so few have introduced the cooking range. By its use their cooking conveniences can be greatly increased, and one of the worst and principal obstructions to pure air in the kitchen be effectually removed. If desired, they can easily be set so as to use the waste heat in warming air enough for an adjoining room, 15 or 18 feet square, without a particle of the odor arising from the cooking.

But let us leave the private dwelling, and examine some of our churches, school-houses, lecture-rooms, court-rooms, work-houses, hospitals, jails, &c. &c. Although much has been said and written during the last two years, on ventilation, we are not aware of a single public building, (with the exception of one school-house,) in this city, or surrounding country, where the directors or trustees have availed themselves of the information and *established* principles which are now accessible to all. Our clergy and trustees of churches have contributed generously and freely to every improvement in the style of architecture, arrangement of seats, and in fine everything in the *tout ensemble*, which is calculated to please the taste, refine the heart, or increase the comfort of those who may choose to worship with them. In one thing, however, they are sadly at fault, and that is ventilation. There is not a single church in Western New York where this subject has received any *practical* attention. We have often been in our own church, when every part of it above and below was full, and have often performed the kind office of assisting ladies, in a fainting state out of the crowd, where they could enjoy the luxury of a little fresh air. We have under such circumstances seen anxious friends run for fresh water and throw it into the pallid face with great violence, and impute the sudden restoration to the virtue of the cold water. Under the same circumstances we have seen the lamps burning very dimly, and a large portion of the audience very restless and uneasy; others so stupified they could not, as they generally express it, "keep awake"; the preacher himself calling for a tumbler of water to moisten his parched throat, so as to enable him to speak audibly; and all this because "*it was a full house.*" The seeds of disease, which have been sown in our churches, have been very prolific, and much of the finest talent engaged in the pulpit, has been rendered useless by the poisonous exhalations of the thousands within the church walls, and the carbonic acid pouring forth from a thousand pairs of lungs. We have seen men go into these crowded as-

semblies three times a day, in obedience to conscience and their religious vows, when they looked and felt as thoroughly exhausted as though they had just arisen from a sick bed. We all know how common it is for persons to take cold under such circumstances, and they fancy it arises from going out into the cold air after being confined in a warm room; while in point of fact they had inhaled effete air, and carried its poisonous qualities into their circulation, until they had produced congestion in the mucous membrane of the lungs long before they left the church. If we could record the diseases which annually originate in the most crowded churches in this country, or publish to the world the number of cases of rheumatism, neuralgia, consumption, and kindred disorders—we think it would startle the most incredulous. If any one thinks we are drawing upon our imagination, we will refer them to those divines, who, in times of general interest, have preached for months to crowded audiences; and let them say what the effect has been upon themselves, or those who have been constant and regular attendants. We will also venture to refer to those faithful sabbath-school teachers who are often shut up in the basement of a church crowded with children; some of whom they have picked up in the streets, and are no cleaner than they should be; the room heated with box stoves, and the ceiling not more than eight or nine feet high; and ask them, what sort of feelings they experience, after remaining in such an atmosphere about an hour and a half.

But all this is submitted to with as much composure and resignation as though it were a special infliction of Divine Providence, and as though no remedy had ever been discovered or proposed. Many of the attendants in our churches would spurn the idea of drinking out of the same glass with one in an adjoining pew, while they are with great indifference inhaling the same atmosphere, which has passed through diseased lungs, and intimately blended with the exhalations of a skin quite inexperienced in ablutions of any sort. Now, it ought to be known to the trustees of churches, and especially to the clergy who have so deep an interest in this matter, that all the expired air and exhalations from the body, can be ejected from the church —no matter how full it may be, and pure air introduced in its place, with about as much ease and certainty as the smoke of combustion can be carried out the chimney-flue prepared for that special purpose. But notwithstanding the attention which has been paid to this sub-

ject during the past two years in several eastern cities, and the perfect success attending the exertion of those who have understood the matter, we believe there is not a single church in this city, which has as yet seriously taken the subject into consideration. The whole expense would be but trifling, not more than a change of drapery for the pulpit, and the whole congregation might have just as pure air at the close of the services as when they commenced.

Barnard's School Architecture — a work which should be in the hands of every school teacher and every friend of education — contains two excellent articles upon the ventilation of school-rooms, and we advise all who have children at school, and desire to know what sort of air they breathe, and why it is they are so often taken ill in the school-room, to read the articles alluded to. This book is or should be in all our book stores, and if teachers and trustees of school districts have done their duty, a copy can be found in each district. Through the munificence of the late James Wadsworth, and under the direction of his son, James S. Wadsworth, a copy of this work has been gratuitously furnished for every district in the State. In that invaluable work, they will find drawings of the plan adopted in Boston and other parts of New England, and they will also learn from the same source that those who have had the matter in charge, consider a school-house *entirely unfit* for occupancy, unless a suitable plan of ventilation has been provided. "Let any one who is skeptical on this point, visit the school-house of his own district where his own children perhaps are condemned to a shorter allowance of pure air than the criminals of the State, and he cannot fail to see in the pale and wearied countenances of the pupils, the languor and uneasiness manifested, especially by the younger children, and exhaustion and irritability of the teacher, — a demonstration that the atmosphere of the room is no longer such as the comfort, health, and cheerful labor of both teacher and pupils require." The class of young men, who usually engage as teachers in our common schools, generally have other objects in view, and do not look upon the occupation as a permanent one; but those who have been for a long time faithfully engaged in a district school well filled with pupils, are almost *uniformly in poor health.* "In looking back," says the venerable Dr. Woodbridge, in a communication upon school houses, "upon the languor of fifty years of labor as a teacher, reiterated with many a weary day, I attribute a great portion of it to *mephitic air;* nor can

I doubt that it has compelled many worthy and promising teachers to quit the employment. Neither can I doubt that it has been the *great cause* of their subsequently sickly habits and untimely decease." If such is the effect upon teachers, what must it be upon the more delicate and sensitive organization of children? Who can compute the amount of disease which has been generated in the school-room, by inhaling the most dreadful poison known to the chemist, — or, how many have been compelled to drag out a miserable existence, arising from some local affection or malformation which had its origin in the confined poison of a school-room? The defects of an early education may be corrected in after life, but a small and contracted chest or diseased spine, a slender form and scrofulous organization can only be palliated — never eradicated. Could we press this subject home upon the parents, trustees, teachers, and superintendents with sufficient *force* to have them carefully examined this question, we should have no fear but that they would cordially unite with Dr. Wyman, of Cambridge, in the opinion that "towns are just as much *bound* to supply children in school with an abundance of fresh air as with teachers." We have in our own city a system of free schools regulated by a Board of Education, and a class of substantial buildings, which may justly be called an ornament and an honor to a town of much greater pretensions than ours. These rooms are all well filled with pupils who are under the charge of excellent teachers; and out of the 16 large brick edifices of this character, only one has any provision for ventilation. The subject, however, is beginning to receive the attention of the Board of Education, and we trust it will not only be *thoroughly* examined; but that they will unite in a plan which will sufficiently simplify the matter to make it easy and practicable for others to imitate them. We have, within the last few years, done much as a State to extend the benefits of education to all classes of the community. The people in their sovereign capacity, have declared that every child shall receive a primary education at the expense of the State. We have had frequent conventions of teachers and superindents, and much has of late been said about school architecture; but scarce a single sentence has been uttered on the subject of ventilation. And is it not strange that a class or convention of such intelligent men as teachers and superintendents, should continue to overlook this important subject? The changes which take place in the air of a school-room, and the horrible consequences which follow this de-

terioration of the atmosphere, are *established facts*, and no one now pretends to gainsay them. From a personal conversation, a few months since, with the Hon. Christopher Morgan, Secretary of State and Superintendant of Common Schools, we know that he feels the importance of this question, and we would here take the liberty of suggesting the propriety of his issuing a circular calling special attention to some system of ventilation to be adopted in every school-house in the State. We are quite sure it would receive general attention, and to a very great extent, have the desired effect.

While the subject of ventilation has been thus neglected in our school-houses and churches, two of our most beautiful halls, owned by individuals, have been thoroughly ventilated. Corinthian Hall, (owned by W. A. Reynolds, Esq.,) is probably the most attractive and agreeable room for accommodating from 1500 to 1600 people, to be found in this State. The public spirited proprietor, about a year since, determined he would avail himself of all the information, he could obtain upon this subject, and, if possible, introduce a sufficient supply of pure air during summer and winter, to meet the wants of all who might assemble within its walls. Without entering into detail of the plan adopted, we will content ourselves by saying, its operation is *perfect*. During cold weather, he warms a sufficient quantity of air by an apparatus—the surface of which, is seldom heated above the boiling point of water, to supply the crowds which nightly assemble for instruction or amusement. In summer the ventilation is forced by a fire in the attic, and under all circumstances, when the hall is literally crowded to its utmost capacity, the air is as sweet, when the audience leaves, as when they enter. We have frequently examined the air just as an audience of over 1600 were leaving, and applied the usual tests for detecting carbonic acid, and could find no trace of it in any part of the room. Concert Hall, (owned by Messrs. Brewster and Blanchard,) has also been supplied with the apparatus, for what may be called natural ventilation. Their heating apparatus has not yet been introduced, but we understand it will be in time for the cold weather. If in warming, the air introduced for ventilation—its wholesome qualities are not injured—the ventilation will be more efficient in cold than warm weather. As by the late construction of a large dome in the center, the summer ventilation is more thorough than it would be under other circumstances.

In our Court Houses, Halls of Justices, and Legislature, the subject

of ventilation has been strangely overlooked. We have often seen upon the bench some of the most intelligent men in the country, suffering severely from the effects of pent up effete air, without being aware of its character, or the cause of their exhaustion and general indisposition. The distinguished jurist, Addison Gardiner, once narrated to us his feelings, while charging the jury in the celebrated case of the People vs. Rathburn. The court-room was densely crowded, and soon after he commenced a review of the testimony, he was seized with a violent pain in his head, and, for some moments, was in doubt whether he could proceed. At one moment he would stagger and be nearly blind, and at others would have such indistinct notions of the question before him, that he was several times at the point of giving up and adjourning the Court; and if as he said the whole charge had not been distinctly arranged in his mind before he arose, he could not possibly have gone through with the task imposed upon him. While he was Judge of the 8th Circuit, he says, such attacks were frequent, and became so alarming, he was obliged to resign. And immediately after his retirement from the court-room, all these symptoms disappeared, and in a few years thereafter he was again induced to accept a similar position in the Court of Appeals; and although he has since enjoyed excellent health, we venture to assert that if this court were held in a small crowded court-room, the same predisposition to vertigo would re-appear, and as he is now of a fuller habit than when performing the duties of Circuit Judge, we doubt whether the termination would be as favorable. The symptoms here alluded to were identical with those produced by carbonic acid gas, and a slight increase of this poison in the Batavia Court-Room on the occasion alluded to, would have been sufficient to produce death.

It frequently occurs in buildings of this character, that a window, most distant from the Court, is raised for the admission of fresh air, and if the wind is blowing fresh from the direction of this open window, the foul air, arising from the lungs and skin of all present, will be driven directly towards the Judge's seat, which is generally raised a few feet above the rest of the audience. With such an arrangement for ventilation, need we wonder at the effect produced upon our Judges? And is there any impropriety in the inquiry, whether even handed justice can be dealt out to all under the influence of such a powerful narcotic? We have often heard it said (and we believe it) that Justice was in very uncertain hands when the Presiding Judge

was under the influence of alcoholic drinks; but we have no hesitation in saying, the intellectual powers were much more vigorous and reliable than when, under the stupifying effect of these noxious gases, so freely generated in court-rooms. If any one will observe the effect upon those distinguished members of the bar, whose services are so valuable that they are generally retained in the most exciting causes, and are consequently kept much of their time in crowded assemblies, we will venture to say, that four out of five of this class, particularly those who attend especially to criminal cases, are soon greatly injured in health, if not broken down in constitution. We should like here to give examples by way of enforcing the truth of these statements, but it would be improper. The bar seem not to be aware of the short lease of life, which such men have. English statistics inform us that while 42 Theologians out of 100, arrive at the age of 70, there are but 29 advocates, attaining the same age.

Jurors, suitors, witnesses, and officers, all suffer alike, but none perhaps endure more for the time being than a country juror. He is in the habit of inhaling the air of his own green fields, and is generally of that hardy constitution, that he can stand the fresh breeze coming through the open window of his bed-room; but when shut up in a crowded court-room, and perhaps half the inmates of the jail seated near him, with the filthy exhalations from their skins, combined with the volumes of effete air issuing from their lungs, and the vapor arising from the tobacco-spit floating before him, he often yields to his indisposition without knowing the cause, and appeals to the mercy of the Court for a discharge. There is not a court-room in this State where the subject of ventilation has received any really practical attention, unless in some new buildings constructed within the last year.

The Common Council of this city and the Supervisors of the County have united in the construction of a very large and splendid edifice for city and county purposes, and the subject of ventilation has received that attention which it deserves; and if no mistakes are made in executing the designs of the able architect who has all the working plans under his control, nor means withheld for completing the plans, we will venture to assert, that it will be the best ventilated public building in this State, except the New York Hospital which has lately been ventilated under the direction of Dr. Watson. We desire to direct the attention of the bar and the bench to this subject; and to say if they will examine with a little care and attention, the

question before us, and look at those about them, whose constitutions have been shattered by inhaling the mephitic gas which is freely generated in crowded court-rooms, they will promptly lend their influence in correcting an evil which has been so long overlooked. Our court-rooms are generally without *any ventilation whatever*, excepting what may be obtained by opening windows and doors. When the weather is cold and the court-room crowded as is often the case, the atmosphere is almost beyond endurance. There is not even the benefit of a fire-flue or fire-place, as it is ordinarily called. Two or three large close stoves, with perhaps a hundred and fifty feet of heated sheet-iron pipe running over the heads of the multitude, heating the rooms up to 80 deg. Far., is the ordinary apparatus for heating a court-room. In these days of progress and improvement in the arts of civilized life, it strikes us as "passing strange," that a profession, combining so much intelligence and such frequent opportunities for observation, should be so careless of a question which makes their daily pursuits almost insupportable.

In some of our halls of Legislation, attempts have been made to introduce the modern improvements in ventilation, but generally with but partial success. In the Assembly Chamber of Massachusetts, we believe a thorough system has been adopted, but in this State and in the House of Representatives at Washington, particularly the latter, it is *very far* from being perfect, and we wonder that the constant complaints of Hon. Members, and the frequent deaths among their numbers, have not ere this induced some positive action which would bring relief. Certainly some of these distinguished gentlemen must be aware of the tests which have been made in England and France; and that it is now settled *beyond all controversy*, that the Representatives' Hall and Senate Chamber can, if necessary, have all of the air taken out of them every 30 minutes, and pure warm air introduced in its place in cold weather, and the heat considerably reduced in hot weather, while the change of foul for fresh air is going on. We will not here attempt to describe the process.

During the last three or four years, quite a large number of meritorious works, illustrating this subject in a great variety of forms, have made their appearance, and he, who now attempts the ventilation of a public building, need not commit any blunders nor fail of perfect success, if he avails himself of the information, which science and mechanical ingenuity have so fully and plainly disclosed. There

are in Washington a large number of public buildings where the question of pure air seems never to have entered the head of the architect, builder, or occupant, and the provision for supplying the inmates with this necessary article, is much more scanty than in our modern prisons and workhouses.

The Smithsonian Institute, now nearly completed, will be one of the most magnificient buildings in this country devoted to science, and since it will be a national ornament, we trust it will be a national model in every particular. It is very easy during its construction, to provide suitable flues for the admission of pure air into each and every apartment, and also to eject the effete air; but if omitted until the structure is completed,—it is then exceedingly difficult and awkward to perfect the arrangement. It is therefore to be hoped that those who have the matter in charge, will not overlook a question of such primary importance. We cannot learn of a single literary institution in the country where this subject has received any practical attention, either from the architect, builder, or managers during the course of its construction; and in such an institution as the one alluded to, it would indeed be unfortunate, if the distinguished gentlemen, who compose the Directors, should follow in the footsteps of those engaged in similar enterprises on a more moderate scale.

Within the last quarter of a century, much has been said and written upon physical education, and while the most observing and reliable writers have dwelt with great force upon the necessity of proper attention to diet and the various kinds of exercise for the development of the body in regular and appropriate proportions; but few of them have directed their investigations to the consequences of a confined atmosphere, or proposed any plan to eradicate an evil which has probably done more to promote effeminancy in our physical organization, than any one cause which can be named. How often do we see the laborious student who is shut up in a close room from month to month and year to year, resemble in the palor of his skin and indisposition to exercise the inmates of underground cellars where the languor produced by the constant use of foul air begets such an indisposition to action of any sort, that the aid of artificial stimulants becomes almost indispensable to produce exertion.

Several of the most intelligent and philanthropic of the medical professions have, during the last two years, directed their attention and efforts to the ventilation of hospitals and prisons. The statistics

which they have collected, prove *beyond all contradiction* the *absolute necessity* of a more perfect system of ventilation than is ordinarily adopted. Many of the most alarming and fatal diseases which run through hospitals and affect every patient in an unventilated apartment, have been entirely checked by a proper system of ventilation. In a building of this character, the ventilation should be constant day and night throughout the whole year, and the amount of fresh air introduced should be such that the sense of smell can detect no difference between the sick room and the air outside. This can easily be attained, if the subject is fully understood, and the directors of hospitals are willing to take the trouble to introduce — what our Creator has furnished in such profusion without money and without price. In hospitals the causes of impure air are more numerous than in any other buildings, containing the same number of individuals, and it is therefore of the first importance that the supply of pure air should be in proportion to the demand and the objects to be attained by providing a public receptacle for the sick. These institutions are generally a charge upon the state, or rely for support upon the generosity of the humane and benevolent portion of the community, and the good intentions of each are practically defeated by retaining in the different wards the foul and contagious exhalations of a diseased and feverish skin, or the vitiated air constantly pouring forth from each pair of lungs. The works of military surgeons abound with facts showing the benefits, resulting from complete and thorough ventilation, and they have given many instances where patients have recovered with great rapidity in ill-constructed barns; where similar cases in well appointed hospitals, have terminated fatally.

Several able articles upon this subject have appeared in the various medical journals of the country, and Dr. Morrill Wyman, of Cambridge, in his treatise on ventilation, gives such full and elaborate directions, accompanied by diagrams, that any intelligent architect can reduce the whole system to practice without any fear of failure or disappointment. Although, but few of the managers of our hospitals and asylums, have fully informed themselves upon this subject, we are satisfied the day is near at hand, when the appalling facts connected with ill-ventilated apartments for the sick, will come home with such force to the hearts and heads of those who have such institutions under their charge, that great criminality will be imputed to them, if they neglect to furnish that, without which all remedial measures, in many cases, will prove unavailing.

In these suggestions, we have had in view the improvement of the small hospitals and sick-rooms connected with our county-houses. A striking instance of the bad effects of unventilated sick-rooms, occurred in our own county-house about three years since when ship-fever was introduced among us. The first cases came under the charge of Dr. Montgomery, and were treated as contagious. The pest-house being then unoccupied, the Doctor had them placed in it and took the precaution to have the room so thoroughly ventilated, that a constant stream of air passed through their apartments night and day. Not a single visitor or attendant was affected by the disease. Subsequently other cases appeared among emigrants, and the attending physician declared the disease was not contagious, and had them removed to the county-house. They were there placed in small, unventilated apartments, and every nurse, attendant, and other person, who came in contact with the disease, took it, and several died. Our object in quoting these cases, as we might many others of a similar character, is to show the necessity not only of ventilation in hospitals, but in sick-rooms in private houses. We believe the best impression now is, that all malignant fevers are, under certain circumstances, contagious, and facts of the most conclusive character go to show that confined pent-up air will communicate it, when, in well ventilated apartments, it would be harmless.

In another place, we have stated other diseases which are communicated in the same way, and we might mention the holds of ships where almost every form of disease is communicated through the medium of foul air. How important it is that every family should have at least *one* room prepared with a perfect plan for ventilating, which could be used, whenever a case of sickness should occur. With such an arrangement, the patient's suffering would be greatly mitigated, its fatality often prevented, and the disease greatly circumscribed in its influence upon others.

In most of our prisons, jails, and work-houses, the ventilation is lamentably deficient. When the prisoners are placed in separate cells, the air is generally so confined and close as to be exceedingly offensive; and in many cases of sickness, it has been proved, that the mere removal of the patient from his close quarters to the apartment used as a hospital, has been sufficient without any other remedies. That terrible disease — the jail-fever — has been entirely prevented by a thorough system of ventilation, and the mortality from other dis-

eases very greatly lessened by attention to this subject. But most of our county-jails have made no provision whatever for supplying the prisoners with that indispensable article, fresh air, and many of our larger prisons have utterly failed in their attempts to supply the cells. It is said that the plan adopted in the Auburn Prison is nearly useless, and that many of the flues constructed for that purpose have been closed in consequence of their inutility. If this is so, it is much to be regretted that those having the matter in charge, should not have learned those simple rules, which science and experience have proved to be unequivocal, under all circumstances, for the certain ventilation of each and every cell. If any one interested in this subject, desires to understand how each cell can be amply supplied with fresh air, we would refer him to the report of the managers of the Pentonville Prison in England. The system there adopted, has been fully tested, and any one, who has made himself acquainted with the laws which regulate the currents of the atmosphere, will see upon a careful examination, that the plan must be certain in its action; and that those who may adopt it, need have no apprehensions of a failure, but, on the contrary, be certain of the most *unconditional success.** We do not, however, advise any one to imitate it, until they *fully understand the whole subject.*

We can hardly speak of any class of buildings where men congregate together for the purposes of devotion, business, or pleasure, where this subject has not been strangely overlooked. In our efforts to shut out the cold air of winter, we have effectually closed every avenue for the supply of fresh air. In our lecture-rooms, concert-rooms, and other places of amusement, wherever a crowd is collected, we generally come away exhausted and oftentimes sick from the effect of "bad air." In our large work-shops, particularly our cotton-factories, the atmosphere in cold weather is intolerable. In the "Jones' Cotton-factory," for illustration, a large steam-pipe passes over the heads of the operatives, and each story is often heated, up to 70 or 80 deg. The air is filled with dust, arising from the cotton, in the various stages through which it passes, from the wool to the cloth; the evaporation of the grease from the machinery, the exhalations from the skins of the operatives, and the carbonic acid from their

* Since writing the above, we have had an interview with one of the most intelligent gentlemen in this country, who visited England with a view of examining the ventilation of the Pentonville Prison; and he stated some facts which induces us to believe the plan adopted has some practical defects which have been strange y neglected by those who have the control of the Institution.

ungs, all combine to make up an atmosphere which fully accounts for the pale and sickly faces which occupy this and similar buildings. Most of the operatives in these establishments are young, inexperienced, uneducated, and poor. They fare no better than they should, while at their homes or boarding-houses, and when driven from necessity into an atmosphere of the character we have described, to work a greater number of hours, and with fewer intermissions than any other class in the community; we ask, if their condition is not deplorable! If there were no remedy for this—if cotton and woolen goods could not be manufactured without a poisoned atmosphere, there might be some apology for this state of things; but wherever there is a motive power connected with the driving of machinery, ventilation is doubly simple and certain. We ask, therefore, if the directors of these establishments are not bound to furnish pure air for those whose lot is, at best, hard enough to excite the sympathy of every philanthropist, who has his attention directed to their condition. We have thus alluded to a few of the prominent causes which render the atmosphere unfit for use, and we propose in our next article to speak more in detail of the popular errors in heating buildings and their effects upon health.

PART II.

The popular or common mode of Heating Public and Private Buildings—The Open Fire Place—Arnott's Chimney Valve—Tight Air Stoves—Ventilating Stoves—Hot Air Furnaces and their Defects.

If we were to go into the history of all the different modes of heating rooms as adopted by different nations, and follow them in their progress to the present period, it would far exceed the limits which we have prescribed. We only propose to speak briefly of the common or ordinary means resorted to among the great mass of our People. It is only some three hundred years since chimneys came into general use; and most of our readers doubtless recollect the old-fashioned mode of building them, as practised and used by your forefathers. The fire-place was often from three to five feet deep, and in some cases from four to eight feet wide. It often required wood enough to make a single fire in cold weather, to supply some families of the present day, two weeks. When one of these fire-places were filled with wood and burning briskly, a very large volume of rarified air was driven up the chimney, and by consequence, an equal volume of cold air must enter the room from some quarter. If the house were well put together, and the doors and windows closely fitted, such a chimney would cease to draw; and the air for the support of combustion, would pass down one side of the chimney—driving part of the smoke into the room, while the balance passed up on the opposite side. To prevent this annoyance, a window must be raised, or a door partially opened. The cold air, rushing in under such circumstances, and passing rapidly towards the fire, was of course a great annoyance. The feet and back of a person facing the fire, would be as cold as in the open air, while the face needed a screen to ward off the radiation from the fire. While this was a very uncomfortable method of warming a room, we have no hesitation in saying, it was much more wholesome than the present tight air-stove and the external air excluded.

It has been found within the last few years that not only the size

of the chimney could be greatly diminished, but that the fire-place could be correspondingly reduced. This diminution of the fire-place and the general introduction of coal—as wood becomes scarce—have done much to increase the domestic comfort of all classes in the community. There are, however, some evils connected with these improvements, which have been quite generally overlooked. The comparatively small amount of air required to support the combustion of a coal-fire in a room of ordinary size, is hardly sufficient for the necessary amount of ventilation, as our houses are generally constructed. All the air that enters through the crevices of the doors and windows, being heavier than the warmed air, falls to the floor and passes regularly along the bottom of the room to the fire. Thus the purest air is used for combustion, while the respired air rises above the opening in the fire-place, and remains in the room. We have in another place stated that air which has been once respired, is entirely unfit to be used again. When a room has been warmed in this way, and occupied by several persons, the air will soon become very bad, if no ventilation has been provided, except the fire-flue. Many persons, who deem ventilation of great importance in their rooms, seem to think an open fire-place all that is needed; but the fact is now well established, that, with the use of a coal grate and a free draft up the chimney-flue, the air may, in a short time, become almost insupportable; and this fully accounts for the fact that such diseases as consumption, and a variety of other similar disorders which are so common in our modern well-built houses, are seldom heard of in those countries where wood is cheap and the old-fashioned fire-place still in vogue. For the purpose of illustration we here introduce a small cut—

Fig. 1.

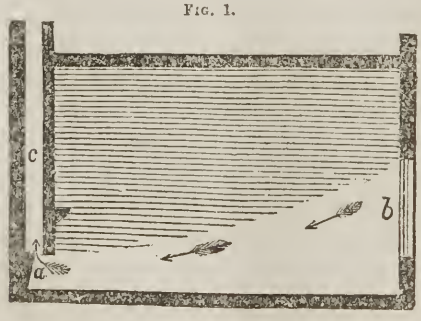


Figure 1 represents a room warmed by a common coal-grate. *b.*

represents a window, and the arrows, the course of the fresh air passing from the crevices directly to the fire, *a*. The dark lines above the white space show the position of the bad air caused by respiration and the exhalations from the body. The foul air will remain in this condition as long as the room is occupied, and if a large number of persons are collected together, it soon becomes necessary to lower a window — whatever may be the consequence upon the health of some delicate or feeble persons who may happen to be present. This illustration is sufficient to show the necessity of proper attention to ventilation, even when an open fire-place is used. Let no one suppose this is an illustration of mere theory. The air, under such circumstances, has been analyzed by chemists who have had their attention directed to the subject, and these facts have been as well established as any proposition in mathematics.

The simplest and easiest mode of ventilating a room, under such circumstances, is by the introduction of a chimney valve invented by the celebrated Dr. Arnott, of London. It should be placed near the ceiling, and the opening communicate directly with the smoke-flue, *c*. An ordinary register, would answer all the purposes for ventilation even if not for the fact that the smoke will occasionally pass from the opening in the flue directly into the room.

Fig. 2.

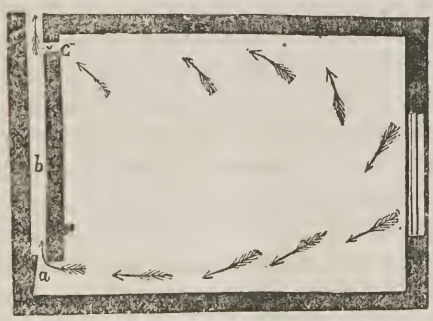


Fig. 2 represents the same room with one of Arnott's Chimney Valves placed in the chimney-flue at *c*. The arrows show the direction of the respired air passing through the valve, and cold or heavier air passing down to the fire-place, *a*, for the support of combustion. In this way all the air of the room is constantly changing, and any person, using an open grate without ventilation, will, upon trying this experiment, be alike surprised and delighted with the result.

Fig. 3.

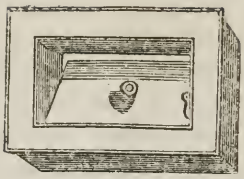


Fig. 3 represents the valve alluded to. It is made of cast iron with a flange sufficiently broad to cover every break which may be made in the chimney-flue. It can be set by any good mason in two hours without in any manner, defacing the wall, and is the only article of the kind, which can be thus introduced directly into the smoke flue, without defacing a finished wall. Its general appearance is neat, and the iron-valve is so nicely adjusted that the slightest pressure of foul air in the upper part of the room will cause the valve to open, while an equal pressure of smoke from the opposite side will cause it to close. If this were the only article of Dr. Arnott's invention, the world would be under lasting obligations to him. The Doctor is one of the most philosophical and philanthropic writers of the age, and for the last four or five years has devoted a very large portion of his time and talents to experiments on the various modes of warming and ventilating public and private buildings, and has done more to enlighten and instruct the public on these subjects than any other man living.

When a room is warmed and ventilated in the manner here suggested, many persons think it superior to any plan which has been introduced. There is, however, one serious evil connected with this mode. As we have before stated, the cold air being the heaviest, it falls directly to the floor. This keeps the feet cold, and is in violation of the old but philosophical maxim—"keep the head cool and the feet warm." The use of the foot-stool for delicate ladies, who complain of cold feet, is very desirable under such circumstances. The feet in this way are often raised above the current of cold air which is passing along the floor; but the air about the head is still at a much higher temperature than at the top of the foot-stool. If any one is skeptical on this point, let him hold a truthful thermometer at the height of the head, and then set it upon the foot-stool. The difference will often be several degrees.

To overcome the evil here suggested, the room should be made perfectly tight, and a current of warm air introduced in sufficient quantities for the purposes of combustion and ventilation.

Fig. 4

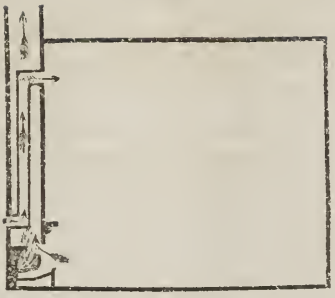


Fig. 4 represents a fire-place with an iron-pipe running up the chimney-flue. The lower end of this pipe communicates with the external air. The fire heats the pipe, the cold air is warmed, made light, and ascends, passing through the opening into the upper part of the room. If the windows and doors are made close, all the air entering the room is warmed, and the temperature above and below will be nearly equal. This plan of warming houses is considered by many, the *very best* ever introduced; but we shall have occasion hereafter to notice its defects. Whenever this plan is introduced, the ventilation should be on the opposite side of the room from the point, where the warm air will be admitted.

In departing from the old fashioned chimney and fire place, society has gained much by the introduction of the present form and size, now in general use. The cheerful open fire is still maintained, and with the simple plan of ventilation which we have suggested, a room may be made very comfortable and the atmosphere remain uninjured, with the exception that it is sometimes rendered much drier than it should be. This evil however is so trifling in comparison with many others that exist in our dwellings, we need hardly mention it in this place.

But when we reflect upon the fact, that throughout the whole country, as soon as fuel becomes a little scarce, the open fire place in any and every form, is pretty generally closed to give place to the STOVE; we meet an evil which has been growing upon us for the last quarter of a century to an alarming extent. It is, however, true that in large towns, particularly where coal is easily obtained, the open grate in the best class of houses is quite generally used. The business of stove-making in most of the large towns in this State and throughout the country, has become quite the leading branch of

manufacturing. Any one who will take the trouble to visit such establishments in Albany, Troy, Utica, Syracuse, Seneca Falls, Rochester, Lockport, and Buffalo, will, if unacquainted with the business, be astonished by the number which are annually turned out from these various establishments. The infinite variety, the taste and skill displayed not only in their external appearance, but in their fuel-saving qualities, demonstrate that the demand must be almost unlimited. The venerable Dr. Nott, of Union College, and Professor Olmsted, of New Haven, and many other intelligent gentlemen, have devoted a great deal of time, labor, and practical philosophy to the invention of stoves which would give off the greatest amount of radiant heat with the least quantity of fuel. In this they have been very successful, and, if *warming* a room in this form, were all that its inmates required, mankind would be under lasting obligations for the philanthropic efforts of these distinguished scholars. From the tenacity with which they have adhered to their several models, one would suppose they were entirely unconscious of the consequences of introducing such a fuel-saving apparatus into a close room without any means of ventilation. Although the Germans, Russians, and French formerly excelled us in their construction of stoves, we are probably quite equal to them at the present day. The poorer classes in Germany and Russia, probably make their houses much closer than ours, and exceed our people in saving all the heat generated. In Russia, the great mass of the population exclude the external air in cold weather as far as possible, and they much prefer to respire the vitiated air to any admission of cold air, for the simple purpose of improving the atmosphere of their rooms.

Among the poorer classes, fainting or asphyxia is, by no means, uncommon, and all their rooms have that close, unhealthy smell which is so common among those who live in underground cellars in our own large towns and cities. With such an atmosphere as this and common as it is among the Russians, we need not wonder that Cholera remains among them during winter, while in cold weather of other countries it ceases. Although many of the most scientific men of the present day—several of whom are of the medical profession—have depicted in the strongest language, the injurious and oftentimes fatal consequences of this mode of heating buildings; still, very little attention is given to their warnings. Within the last two or three years, many of the most distinguished writers of the age have written

volume after volume, upon the necessity and feasibility of ventilating our dwellings. The great mass even of intelligent and educated persons seem to be unaware of the disease, pestilence, and death, so often resulting from the use of what is called the "tight air-stove"; and the manufacturers of the article are making as many preparations for the continuance of the demand as though their wholesome qualities were as well established as the elegance of their various designs and patterns. It is a very common thing for persons who are abundantly able to secure all the comforts of life even in profusion, and construct a dwelling-house in strict accordance with all the modern improvements in domestic architecture, to leave out entirely the fire-place, and in its stead have a small circular opening, six inches in diameter to be closed perfectly tight during summer, and opened only in winter; to receive the smoke-pipe of a fuel-saving salamander, which shall admit no more air than is barely sufficient to support the combustion of the fuel. He will avail himself of the skill of the architect, to make all his windows and doors perfectly tight, and as the cold weather approaches, he will oftentimes invite his neighbors in to spend the evening socially, and at the same time demonstrate by the small amount of fuel which he uses, that he has the best stove and the warmest dwelling in town. Indeed, the whole company will soon testify to the fact that the room is really warm — so warm that they are inclined to leave early in the evening, and if the same persons should frequently visit similar establishments, they would soon come to the conclusion, that going out on evening visits is very unwholesome — a species of dissipation which ought to be abandoned. The owner of such an establishment, as the one alluded to, is generally far from being parsimonious, and very likely fond of giving sumptuous entertainments, and in all his intercourse with his family and society may manifest the most generous feelings, and show his liberality in a thousand acts of kindness and benevolence; but did he know the consequences upon himself, family, and friends of his heating apparatus, its fuel-saving qualities would have very little influence upon him. We are fully aware that to those who are very poor, and find it hard in cold climates to secure fuel enough to keep themselves warm — the tight air-stove is perhaps the best thing for them under such circumstances, which can be introduced into their humble abode. But in such rooms as they are generally obliged to occupy, they suffer much less for the want of ventilation than those who live in houses where all the windows and

doors are so nicely fitted, that the external air is entirely excluded. In many of the coal-stoves which have lately been introduced, the coal burns so slowly, that the carbonic acid gas, which is generated (being half as heavy again as the atmospheric air,) cannot ascend through the smoke-pipe and chimney-flue with the temperature which is generally maintained a few feet from the point of combustion. Dr. Ure, one of the most scientific writers of the day, says that "carbonic acid gas cannot ascend at the temperature of 250 deg. F." but regurgitates into the apartment through every pore of the stove, and poisons the atmosphere. "I have," says he, "recently performed some careful experiments upon this subject," and find that when the fuel is burning so slowly in the stove as not to heat the iron-surface above the 250th or 300th degree of Fahr., there is a constant deflux of carbonic acid gas from the ash-pit into the room. "I shall, (he says,) "be happy to afford ocular demonstration of this fact to any incredulous votary of the pseudo-economical, anti-ventilating stoves now so much in vogue. There is no mode in which the health and life of a person can be placed in more insidious jeopardy than by sitting in a room with its chimney closed up with such a choke-damp—vomiting stove."

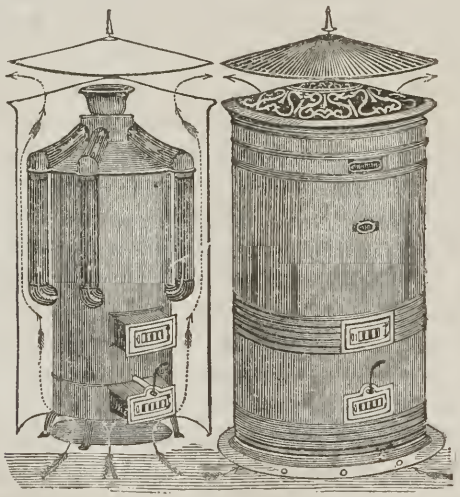
We could quote language and facts of a similar character from a great variety of the most reliable authors, but if we can induce any of our readers to observe the consequences in their own dwellings of these modern machines, we shall have gained more than by simply inducing them to peruse these opinions, however reliable, they may be. In most of our churches, public halls, school-houses, court-rooms, places of public amusement, offices, stores, work-shops, &c., we meet in this section of the country, the same unwholesome atmosphere; and almost the only variety to be observed in the mode of heating the room is in the *form* of the stove. If you enter a public hotel, the first thing you meet in the office or bar-room (if in winter,) is a large box-stove. If you go to the dining-room, you meet the same thing again, with perhaps a hundred feet of smoke-pipe crossing the room at different points; and if the offensive character of the atmosphere gives you a sense of fullness in the head, while perhaps a disposition to vertigo compels you to leave the public rooms and retire to the one alloted to you. Then you will probably find a neat little elegant gothic pattern red-hot by way of showing you a little variety, and if you are compelled to lower a window for your relief, and wake up at

midnight with a severe cold, you may console yourself with the fact, that your beautiful little stove is of the latest and most approved fashion, and consumes less fuel than any one ever before invented. If you stop long in the place, and stay over the Sabbath, and have been properly educated, you will of course go to church, and it is your own fault if you do not find one of beautiful proportions, handsomely finished, and elegantly decorated. The stove will be larger than the one at your hotel, and one will be placed in each corner of this splendid edifice. The sexton will fire up as often as is necessary, and keep you perfectly warm. It is true the air may soon become very disagreeable, and the eloquent voice of the speaker sound dry and husky; if he cannot relieve it by moistening his vocal organs quite frequently with cold water, you may not be at all pleased with its tones, silvery and agreeable as they were at first. But do not blame him. He is suffering for the purpose of keeping the audience *perfectly warm*, and if you see a considerable proportion of the congregation asleep, particularly if the house is *full*, do not wonder at it, for the atmosphere has been so thoroughly dried and respired that there is not oxygen enough remaining to give them the ability of keeping awake. If now and then a delicate lady near you faints away, help her out as quick as possible into the fresh air. You need not send for a pitcher of fresh water to throw in her face. The pure unadulterated atmosphere is abundantly sufficient to restore the circulation, though she may suffer some time afterwards. This kind act being performed, you can return again to the church much invigorated. If after this experience you come to the conclusion that all these difficulties are caused by the use of a close stove, you need not mention it to others, for they have heard of it before. If your own house is warmed and ventilated according to modern notions, you may perhaps congratulate yourself in leaving the town. In the rail road cars, you expect to get into a different atmosphere, but as soon as you enter, you will only find a different pattern of stove made *expressly for rail-roads*. The passengers may insist that every window shall be kept closed, and you have no alternative but to remain a victim to the foul pent up air which is so common under such circumstances, until you reach the end of your journey.

We have spoken thus freely of the use of the common box and tight-air stove, and did we not know from experience and observation, and were we not supported by the highest medical authority, and

most unequivocal chemical tests, that the evils resulting from their general use far exceed any and all of our allusions, we should hesitate as to the propriety of attacking a system which is so universally adopted. We know that many persons have their houses so constructed, that it is difficult for them to make any change in this department of their domestic arrangements. But if we shall be successful in inducing those who have seen and felt the evil effects of heating their houses, without any reference to ventilation or the quality of the atmosphere they inhale at every breath, they will be the better prepared to appreciate the improvements which have lately been introduced. In some parts of the country, several attempts have been made to introduce a kind of stove which will warm a current of fresh air directly introduced from the outside. It is impossible to ventilate a room by drawing off the foul air without introducing a corresponding amount into the room from some source. If cold air be introduced for the purpose of ventilation, all the warmed air will pass off through the ventiduct, and the cold air remain. We need hardly say that, under such circumstances, it is impossible to make a room comfortable. To overcome this difficulty, a ventilating stove has lately been introduced in different parts of Europe and in some of the Eastern towns of this country.

Fig. 5. Fig. 6.



Figs. 5 and 6, represent a stove of this character, invented by Dr.

Clark, of Boston. This stove is composed of two cylinders, and is in quite general use in many of the common schools in and about Boston. Fig. 5 represents the inner cylinder, or stove proper. Fig. 6 represents the external cylinder, and when in use the external cylinder is all that is seen. The lower part of the outer cylinder is connected directly with a pipe or flue leading directly to the open air. As the inner cylinder is heated, the air is warmed, and rises in the direction of the arrows, and passes directly into the room. In this way the space between the two cylinders becomes an air chamber, drawing a constant supply of fresh air from the outside. It needs but a moment's reflection to perceive that if a stove of this character is properly constructed, most of the evils complained of from stove-heat may be avoided. If, however, the inner cylinder is raised to a very high temperature, sufficiently so to burn the air, the atmosphere of the room may still be more or less unwholesome. This stove with proper attention need not necessarily be overheated, and if not called upon to do too much, it will answer a most excellent purpose. But when placed in a large room and the weather very cold, we have seen it at a red heat, and the air thus heated presents a most disagreeable odor — and as a matter of course more or less unwholesome; but even under such circumstances, it is a great improvement over the common box, or any variety of the tight air-stove. Several designs for ventilating stoves have lately made their appearance, but the inventors appear to have no other object in view than that of raising the air to as high a temperature as possible. Some of them have small tubes not more than two inches in diameter, sitting directly around the fire-pot, which are easily raised to a red heat. Of course the air, passing through these tubes, is greatly injured. In the construction of a ventilating stove, the air to be warmed should never be brought into contact with the surface raised above 212 degrees—the boiling point of water.

In the use of a stove of this description, the expense of fuel is but a trifle more than that of the tight air-stove, and when we take into account its advantages, we think no one, who is enabled to enjoy an ordinary share of the comforts of home, can object to them on that ground.

Another mode of heating houses, which has of late received a good deal of attention, is that of hot-air furnaces. It consists in placing a large stove, generally with a series of drums in the cellar or some un-

derground room, and enclosing the whole in a brick chamber. The cold air is introduced from the outside within the walls which enclose the stove, and by the heat, communicated from the stove thus enclosed, it is made lighter, and conducted through some metalic pipe into the room or rooms to be warmed. In this way, every room in a dwelling may be kept to a uniform temperature without any of the annoyance or inconvenience of a stove or fire-place in the rooms above, arising from the frequent renewal of the fire by the introduction of fuel, the dust from the ashes, &c. This is a great improvement, and most persons much prefer it to the use of the fire-place or open stove. It is but a short time since they have been introduced into this section of the country, and comparatively few have availed themselves of their benefits. Most persons, who have been engaged in setting them, have had little or no experience in the business, and a very large portion of those hitherto introduced, have proved quite unsatisfactory. Most of them are so constructed that the fire-pot and all points near the combustion are generally kept red hot, and oftentimes we have seen them to a white heat. To save what heat would otherwise be lost, a great variety of drums, diving and horizontal flues have been invented to check the current of heat before it passes off through the smoke-pipe into the chimney. Those engaged in making furnaces of this character contend that they have arrived at the very maximum of economy, when they can point to the fire-pot at a white heat and at the same time hold their hand upon the smoke-pipe at the point where it emerges from the chamber for heating the air. Any one who is acquainted with the fact that a red-hot surface greatly deteriorates the air, and that the point where the temperature is as low as that alluded to, can effect very little in warming the air, will readily perceive that the latter point is worse than useless.

Fig. 7.

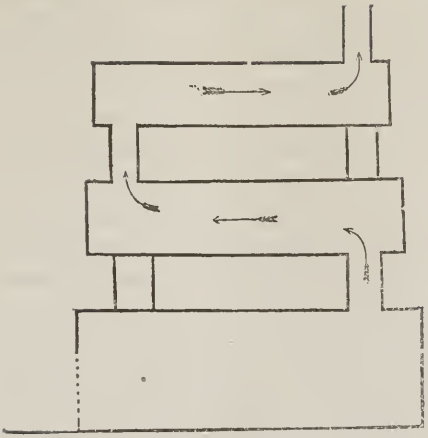


Fig. 7 represents a horizontal section of a furnace which was at one time in more general use than any other in this section of the country. It is nothing more than a large box-stove with two or more cast-iron drums directly over it. The dotted line in the lower part of the figure represents the opening for the introduction of fuel, and the small arrows show the direction of the heat through the drums. The lower part, or stove where combustion is carried on, is easily raised to a very high temperature. In the first drum above, the temperature would be much lower. The third much less and so on for any number of drums till the heat would be nearly exhausted. They are all made of heavy cast-iron, and, at the point where the heat enters the first drum, the temperature would be very much higher than at the opposite point where it entered into the next drum. This mode of heating causes irregular expansion and contraction of the iron-plates —the joints would soon be partially separated, and the plate itself often cracked. As soon as this occurs, the furnace will begin to leak the smoke and gases of combustion into the air chamber, which, when combined with the burned air, would constitute an atmosphere, anything but desirable for those who are obliged to inhale it. When the air to be heated is first introduced, it is at the bottom of the air chamber, and is first brought in contact with that part of the furnace, most highly heated; and its temperature cannot of course be increased by passing over on its way up a series of drums at a much lower temperature. All furnaces, therefore, which are thus irregularly heated,

or have open joints or cracks, are entirely unfit for use, and these defects have done much to prejudice people against their use. Many persons have endured them — notwithstanding these objections, in consequence of the facilities afforded for keeping all parts of the house at an agreeable temperature. Since their first introduction into the country, a great variety have been invented, but the most of them have the same defects manifested in a different form; as the simple illustration we have here given. A furnace properly constructed should have all the joints so accurately fitted together, that none of the gases of combustion can by any possibility escape into the air chamber, and its form should be such that all parts of it will be heated to a uniform temperature. Every person who has had any experience with stoves, knows that when they are at a red heat, the atmosphere of the room where they are placed, soon becomes intolerable. A furnace, at the same temperature, will of course affect the atmosphere in the same way. Many of the furnaces, which have been introduced among us, in addition to the objections here alluded to, are so constructed, that when the soot and ashes accumulate in the drums or flues, there is no mode of cleaning them out; and many who have been quite delighted with their use at first, have been equally dissatisfied with them afterwards.

Most of those who have been engaged in manufacturing them, seem to have lost sight of the uses to which they were to be applied; and their whole object seems to have been to heat the air to as high a temperature as possible, and they seem to have lost sight of the idea, that the air thus heated, was to be used for respiration and ventilation as well as for the purpose of warming the rooms into which it should be conducted. While one furnace has been constructed with a series of drums as before stated, another one is so made that, by the turning of a damper, the heat is sent into a number of diving flues at a point as low as the fire-pot, then brought up again, and finally carried off to the smoke-pipe or chimney, through horizontal flues. Last fall or winter, a number of furnaces were introduced into this place with a number of small tubes placed directly around the top of the fire-pot in such a manner, that, whenever the combustion was at all active, they were uniformly at a high red heat, and the air to be warmed was compelled to pass through these tubes which were of some two and a half or three inches in diameter, and two or three feet long. If the inventor of this furnace had designed to injure the air to the full-

est extent within his power, we doubt whether he could have changed his plan without failing to some extent in the accomplishment of his designs. Aside from the faulty construction of these furnaces, the mode of setting them has, in most cases, been equally objectionable. With a view of saving heat, a double brick-chamber has generally been constructed, and the air introduced at the top, taken down between the two walls, and introduced to the heating apparatus at or near the bottom of the inner wall. It often occurs in such cases that when the wind is blowing from the opposite direction of the pipe, conveying the cold air to the furnace-chamber—and when the door or window to a room, receiving the warm air, is suddenly opened the air passes directly from the room down the pipes intended to bring up the warm air, and passes through the furnace-chamber out of the cold air-flue. The inner brick-wall, before alluded to, is often placed so near that part of the furnace which is the most intensely heated, that the radiation from the fire-pot soon heats this part of the brick-chamber to a high red heat; and that in return becomes an extended heating surface for the air to pass over. If any one has any curiosity on this subject, let him pass air through a brick-flue, when at a high red heat, and notice the effect, after being inhaled, upon the respiratory organs. In addition to the difficulties which we have alluded to, it should be borne in mind that the means ordinarily resorted to for supplying the air with the necessary amount of moisture, are also very defective. In all this class of furnaces, when any attention whatever is paid to evaporation, a metalic basin of some sort is either placed at the bottom of the air-chamber, where it receives very little warmth, or at some point higher up, and against or on the main heating cylinder where the water often boils. In the first position there is a very great deficiency of moisture, and in the last great excess. We might here multiply cases and descriptions of these defective furnaces, and equally defective mode of setting; but as we propose in another place to speak more at length of the recent improvements which have lately been introduced to public notice, we have perhaps said enough to enable the reader to point out for himself the leading objections which we have suggested; and in conclusion of this branch of our subject, we will only say that any mechanic (however well he may be informed on other subjects,) who undertakes to construct a furnace and put it in operation, without understanding the laws which govern the atmosphere, and the various changes through which it

passes during its preparation for domestic use—or is ignorant of the laws which regulate its currents under an infinite variety of circumstances,—will probably soon regret that he was ever induced to enter into the business.

PART III.

Practical Suggestions upon the Advantages and Disadvantages of the different Modes of Warming Air—The use of Steam—Hot Water—Furnaces—Recent Improvements contrasted with the Plans in general use—Difficulties to be surmounted—Evaporation—Ventilation—Conclusion.

In a climate like ours, no art which Divine goodness has placed within our reach, is more valuable than that of generating and distributing heat. Many of the most scientific and philanthropic men the world ever saw, have devoted great care, application, and attention to the different modes of applying heat, so as to meet the wants of all classes and conditions of society. The efforts of Count Rumford, in simplifying the process of warming rooms, deservedly acquired the highest honor. His exertions experienced the sneer of the wit-worms of his day; but the approbation of the benevolent and the gratitude of that class whose comfort and happiness he sought to establish, greatly overbalanced the jeers of those who feast upon ridicule, and are incapable of appreciating a disinterested act of any sort.

Since the great advances made in the construction of chimneys, the general introduction of coal, and the mode of setting grates to radiate the greatest amount of heat, philosophy and the mechanic arts have suggested a variety of modes for distributing a genial warmth to all parts of a building, where it might be needed. Sir Hugh Platt, in 1652, suggested that a conservatory might, at a small charge, be heated by the use of steam. His plan was, indeed, very simple, and consisted in placing a "tin-cover over a boiling vessel wherein you boil your beefe, or drive your buck, which, having a pipe in the top, and being made in the fashion of a funnel, may be conveyed into what place of your orchard or garden, you shall think meete." About 100 years after this, the subject was brought before the public in a more practical form; but it received very little attention until within the last fifty years. At various periods during the present century, the subject has been discussed, and many able authors commend this mode of

heating, as decidedly preferable to all others. There has been but little improvement in the machinery used since its introduction by Messrs. Boulton and Watt, some fifty years since. At one time this mode of warming buildings was received in England, France, and Germany with great favor; but latterly it has to a great extent been abandoned. The practice of heating rooms by the radiation from steam-pipes, without ventilation, is, in our opinion, no better than the smoke-pipe of a close stove, if the joints are so fitted that the gases of combustion cannot leak into the room. We have often examined buildings which were warmed by steam-pipes running along or near the base-board, or perhaps coiled in one corner of the room, and found the air exceedingly offensive. We visited, a few months since, the New York Hospital which has during the past winter been heated by steam, and *thoroughly ventilated.* The steam-pipes are coiled in an air chamber, and a volume of air is warmed and distributed in all the wards. Great attention has been given to the subject by Dr. Watson, a gentleman of high professional attainments, who had the whole detail under his own direction; and it may, with great propriety, be copied by other institutions, when the introduction of steam has been decided upon. We noticed one room where the heat was from the direct radiation of the steam-pipes, and the difference between that and the rooms warmed by a current, direct from the air chamber, was—to say the least of it—sufficiently striking to illustrate the two systems, and condemn the practice of resorting to the use of steam without ventilation. The machinery and improvements connected with its introduction in the Hospital, cost upwards of $50,000, and it requires an engineer and two assistants to manage it. This shows that but few institutions in this country can resort to this method, even if there were no other mode of warming the air without injuring its wholesome qualities. The same statement connected with the fact, that none but a careful person, more or less familiar with the steam-engine, can be entrusted with its care, shows its impracticability for private dwellings. Very large and wealthy institutions may resort to it, and use the steam and engine for a variety of purposes, besides warming and ventilating the apartments.

Mr. Tredgold, one of the most scientific authors upon the nature and distribution of heat, recommends steam as the only mode, in which a building can be heated, without injuring the atmosphere; but Mr. Bramah, who added an appendix to Mr. Tredgold's work,

some years after his death, states, that the author, soon after the publication of his work, became satisfied that the mode of heating by hot water was decidedly preferable to steam; though he had at one period condemned it as impracticable, and, upon philosophical principles, unattainable.

During the last few years, several works have made their appearance, strongly recommending the hot water apparatus as decidedly preferable to steam. The use of steam, for the purpose of distributing heat throughout a large building, was designed and intended to overcome the objections so strongly urged against stoves and hot air-furnaces, whose surfaces were often raised to so high a temperature, that the air, coming in contact with them, was rendered unfit for use. Steam-pipes, upon what is called the high pressure principle, are often raised to the temperature of 400 to 500 degrees, while a low red heat of a stove is about 700 degrees. In the hot water apparatus the heated surface must always be below 212 degrees, the boiling point of water. This fact alone has given the latter plan the preference. There are a variety of plans for warming buildings by hot water, some of which are exceedingly simple, and others quite complicated. The principle however, is the same in each case. The expense for an ordinary dwelling house is some three or four times that of introducing a warm air furnace. Aside from the expense, it must be remembered that the constant supply of water is often difficult, and the liability to get out of order is much greater than in the use of the furnace. There are, however, some points about this mode of distributing heat which strongly commend themselves to the favorable consideration of those who are abundantly able to meet the extra expense of construction and alteration. Many contend there is no other mode of warming the air without injury. With a heating surface which in no case can be raised above the boiling point of water, the air, they fancy, must, under all circumstances, be perfectly pure, and never be "robbed of moisture or injured in quality." In England this system is, with many, quite popular, and it is better adapted to that climate than our own. The cold with us is much more intense than in Great Britain, and a hot water apparatus of sufficient size to warm a building at 28 or 30 degrees would be quite inefficient when the temperature is at Zero. This kind of apparatus is at its maximum when the water boils, and can accomplish but little before the boiling point. The same apparatus therefore must be used, and the surface

brought to the same temperature on all occasions, and at all degrees of eold. An apparatus therefore of sufficient size to warm a dwelling when the temperature outside is at Zero, will give off a great excess at 32 degrees, the freezing point. The prejudices which have existed and continue to exist against hot furnaces are most generally well founded. Most of those who have been engaged in their construction and introduction seem to have had only one object in view,—that of *heating* the apartments when it is introdueed. If the weather is intensely eold, they apply the more fuel, and increase the temperature of the heating surface, until it is often at a *white heat.* The same sized furnace is designed for a dwelling with double windows, and well formed walls, as for one of the same size with single windows, and with walls plastered directly on the surface of the stone or brick work. The mode of setting the furnace in an air chamber, and the introduction of the air to be warmed, are very likely in direct violation of those unalterable laws which regulate the radiation and eonduction of heat, and control the atmosphere in all the changes which it undergoes in its rarification and condensation, while passing through the air chamber, and distribution in the different apartments. Within the last few years, the public have been eautioned against the effects, of a heating apparatus, any portion of which, is raised to or near a red heat. It is very common, therefore, for the dealers in these articles to declare and advertise that no part of it is ever raised to such a temperature, while any person, at all familiar with the laws of heat, will see, at a single glance, that an active combustion of fuel must produce the effect alluded to. Those writers, chemists, and philosophers, who first depicted the eonsequences of warming the atmosphere by a red-hot surface, supposed and declared that the oxygen was partially destroyed; but it has since been ascertained by a more accurate analysis, that the loss of oxygen was not the cause of the difficulty. The air, after passing through such an apparatus, was found after being cooled to contain in most instances the usual amount of oxygen. This fact has been greatly perverted, when used to show, that a metalic surface at a red heat, did not injure the atmosphere.

We cannot better answer this position than by the following quotation from Mr. Charles Hood, an English author, who has written a most exeellent practical volume of some four hundred pages upon the warming and ventilating of buildings. After speaking of the different methods of distributing artificial heat, he says, "Many of these

methods are highly injurious to the animal economy, and cannot be persevered in without permanent derangement of the health of those who are exposed to their influence. There are always suspended in the air myraids of particles of animal and vegetable matter, but these almost unheeded atoms possess a high philosophical importance; however they may, generally, be disregarded. They are the evidences of the unceasing changes which the material world is continually undergoing—the irrefragable proofs that the visible matter of the universe is slowly and almost imperceptibly, passing through a series of transmutations which affect both organic and inorganic nature. Many of these particles are easily decomposed by heat, and are then resolved into the various gases either in their elementary or mixed state. Hence many of the methods of producing artificial heat, are materially affected, as regards their wholesomeness, by the fact of their being able, or not, to decompose or chemically alter these floating particles of matter. To this cause is mainly attributable, the unpleasant smell produced by several modes of warming buildings by highly heated metalic surfaces, and we have already seen that the hygrometric and electric condition of the air is also altered by the same means." All the different descriptions of hot-air stoves are more or less liable to these objections, as also the high pressure system of hot water apparatus, and still more, the cockle or hot air-furnaces. Dr. Nott's stoves, and also the Russian and German stoves, are subject to this inconvenience. But the cockle or hot air-furnace is particularly liable to these objections; for not only will it act powerfully in decomposing the floating particles of extraneous matter in the air, resolving them into sulphuretted, phosphuretted, and carburetted hydrogen, with various compounds of nitrogen and carbon; but it will likewise decompose a portion of the vapor contained in the air, absorbing the oxygen and liberating the hydrogen.

These various gases, thus exhaled into the air, cannot be breathed without considerable inconvenience. Signor Cardone made some experiments on breathing hydrogen gas. He inhaled thirty cubic inches which is about one-ninth part of the total quantity of air contained in the lungs, and the almost immediate effect he experienced, was an oppressive difficulty of breathing, and painful constriction of the superior orifice of the stomach, followed by abundant perspiration, tremor of the body, heat, nausea, and violent head-ache; his vision became indistinct, and a deep murmur confused his hearing. Some

of these symptoms lasted a considerable time and were, with difficulty, got rid of. Sir Humphrey Davy tried the effect of inhaling carburetted hydrogen. He made three inspirations of the gas. The first inspiration produced a sort of numbness and loss of feeling in the chest and about the pectoral muscles. After the second inspiration, he lost all power of perceiving external things, and had no distinct sensation, except a terrible oppression on the chest. During the third inspiration this feeling disappeared, and he seemed sinking into annihilation, and had just power enough to drop the mouth-piece from his unclosed lips. The effects of this experiment lasted for several hours, producing excessive pain, extreme weakness, nausea, loss of memory, and deficient sensation. Carbonic oxide is still more prejudicial in its action on the animal system. Sir Humphrey Davy, on trying the effects of inhaling a small quantity of it, was seized with a temporary loss of sensation—succeeded by giddiness, sickness, and acute pains in different parts of his body; and it was some days before he entirely recovered; but Mr. Witter of Dublin, who tried to repeat the experiments, was immediately affected with apoplexy, and was restored with difficulty.

We might continue to quote similar opinions from late authors, but it is perhaps enough to say, that no well-informed writer in any manner, contradicts the statements of Mr. Hood, but, on the contrary, he fully coneurs with him by the expression of similar views.

Recent improvements have demonstrated, that a furnace can be so constructed that the heating surface need never be raised above the temperature of 212 deg., and if so, it is of course just as good for warming air as though its inner surface were filed with boiling water, and, at the same time, free from the objections and inconvenience suggested. A few years since it was ascertained that certain apartments in the London Custom House, produced ill-health among the officers whose official seats, were placed in them. Mr. Bernan says, "the whole of them complained of a remarkable coldness and languor at their extremities, more especially the legs and feet, which became habitual. Others complained of a sense of tension or fullness in the head, with throbbing of the temples, and vertigo followed not unfrequently, with a confusion of ideas very disagreeable to those engaged in important and sometimes intricate calculations." The medical gentleman, who was consulted, recommended the removal of the stoves, and, in their stead, pipes heated by steam, laid along the floors.

Dr. Arnott was subsequently consulted and employed. The steam-pipes were not introduced; but a "comfortable and wholesome climate was produced in the long room which contains over half a million cubic feet of space, by means of three warm air-stoves of his contrivance." The room which he warmed in this way, is 186 feet in length, 64 feet in width, and 44 feet in height. These stoves contained 800 feet of heating surface, and weigh 6¾ tons. The surface was seldom heated above 137 deg. With the system of ventilation introduced at the same time, this simple arrangement was found to be very economical and the air quite salubrious. All the disagreeable symptoms which previously existed among the officers and clerks, disappeared, and the same apparatus continues to the present time; and we believe without any desire to change it. The whole arrangement shows great ingenuity, and is based upon the most philosophical principles. Some two or three years since we had constructed a warm air-furnace for our own dwelling, intending as far as practicable, to carry out the philosophy of Dr. Arnott. We failed in some of our first attempts, but subsequently succeeded with a comparatively small amount of fuel in obtaining a sufficient amount of heat and an atmosphere as salubrious and agreeable as need be desired. To prevent all possibility of having any point in the heating apparatus raised to a very high temperature, the fire-pot, or point where the combustion was carried on, was entirely excluded from the air chamber. We conceived the idea of this size and form, from what is called a "patent English Baker's oven." We noticed that an oven of this shape could be heated to a red heat in a very short time, by making the fire outside of the oven and conveying the heat in at one corner, and taking it out at an opposite corner of the same end. We therefore had a sheet-iron drum made of a similar form, and the heat introduced in the same way. The drum was enclosed in a brick air chamber, and could, in a very short space of time, be raised to the desired temperature. This drum was six feet wide, eight feet long, eighteen inches high at the sides, and two feet and a half high at the centre—the whole containing about one hundred and fifty feet of heating surface. We were so well satisfied with its working, that several personal friends and acquaintances adopted a similar method in warming their own dwellings. All these furnaces were designed for burning wood, as it was then a cheaper article of fuel than coal. To keep this kind of furnace at a uniform temperature required but little fuel at a heat but

needs constant replenishing. As the furnace must generally be placed in an underground room, such a frequent renewal of the fire must of necessity be very inconvenient; and families, no more systematic than they should be, will quite likely tire of such an apparatus, particularly when the fires are made by the kitchen-girl who sometimes arrives at the *strange conclusion*, that some one else ought to be employed to make the fires.

To overcome the difficulty of this frequent and regular renewal of the fire, we recommended after a great variety of experiments, an entirely different form for the construction of the drum, by which a larger amount of fuel could be introduced and burned much more slowly. It contained the same amount of heating surface, and the whole could easily be raised to a uniform temperature. We considered this an excellent substitute for a hot water apparatus, as it was intended never to raise the heating surface above 212 deg. That such a furnace can easily be constructed, and that it has all the advantages of the hot water system without its inconvenience, no one who carefully examines the subject, need doubt. Of course it must be constructed of a good quality of iron, and all the joints and connections be as firmly fitted as though it were to hold water or steam. If this is done, none of the gases of combustion can leak into the air chamber; and if the iron is of sufficient thickness, to resist the injury from rust, it will, for aught we can see or learn from the best authorities and sheet-iron workers, be a durable apparatus. The proprietor of Corinthian Hall, uses two of these furnaces, and he informed us a few days since that it met his highest expectations, both in respect to the quality of the warmed air and the ease, with which they could be managed. The two contain about 325 feet of heating surface. He says the hall has been warmed nearly every evening during the cold season with the use of but fifteen cords of wood. The mode of setting this furnace is somewhat peculiar. We had intended to give the reader a more definite idea of it by an engraved figure; but we have been disappointed in obtaining it. We have thus dwelt somewhat in detail upon the furnace, invented by Dr. Arnott, and the one introduced among us, to show that the expense and inconvenience of using hot water is quite unnecessary.

This kind of furnace is, however, quite expensive, and with a view of calling attention to what is ordinarily called a portable furnace, we here introduce an engraving of one constructed upon the same prin-

ciple, and capable of warming three or four common sized rooms and a hall—

Fig. 8.

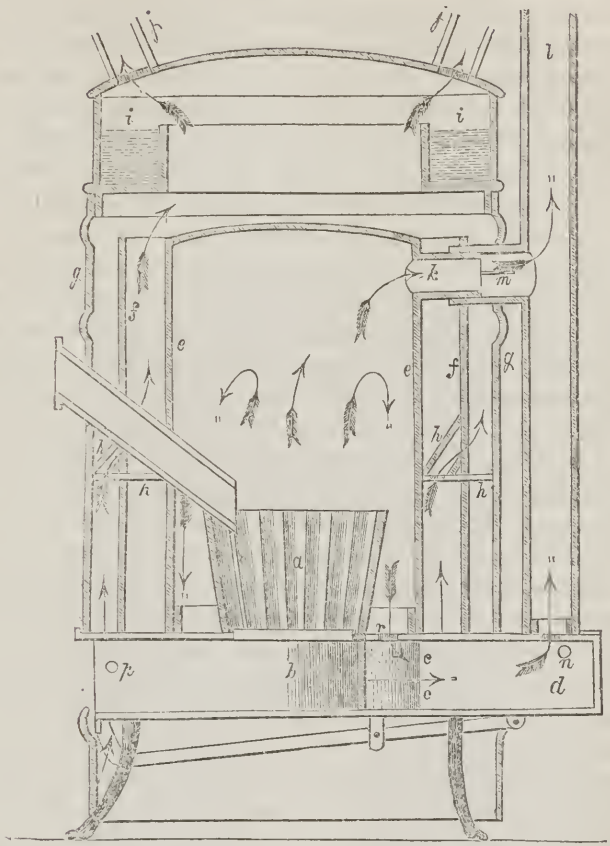


Fig. 8 is a vertical section through the centre, showing the fire-pot and the different cylinders: *a.* represents the fire-pot which is constructed of heavy cast-iron, one inch in thickness; *b.* is the ash-pit; *c c.* is a circular passage around the ash-pit; and *d.* is a tube, leading from it to the bottom of the smoke-pipe; *e e.* is a sheet-iron cylinder, called the heating cylinder. This encompasses the fire-pot, *a.*, and fits tightly over the top of the base which receives the fire-pot, *a.* Between the heating cylinder, *e e.*, and the fire-pot, *a.*, circular openings are formed through the base, which receive the smoke and gases of combustion; and which terminate in the tube, *d.*—the heating cylin-

der, *e. e.*, is larger in diameter than the fire-pot, *a.*, and extends some distance above it, and is closed at the top by a circular casting made with a flange or shoulder, so as to fit very close, and make the whole sufficiently tight to prevent any of the gases of combustion from escaping and combining with the air to be warmed. *ff.* is a radiating cylinder, also constructed of sheet-iron of a lighter quality, which surrounds the heating cylinder, *e e.*, and is opened at the top. The lower part fits tightly over a small vertical projection of the base. *g g.*, is the outer cylinder which incloses the whole as seen in Fig. 8, and is generally constructed of galvanized iron. The space between the outer cylinder, *g g.* and the inner cylinder, *e e.*, is divided perpendicularly by the radiating cylinder, *ff.* When the combustion is going on, the inner cylinder is heated, and the radiation from this affects the radiating cylinder, *ff.*; as the external air is introduced between the three cylinders, that which is between the radiating and heating cylinder, will of course be raised to a much higher temperature than what is passing up between the radiating and outer cylinder. To prevent these currents, passing into the apartments at different temperatures, a flange, *h h.*, is thrown across from the outer to the inner cylinder. The openings in this flange are so formed that the air, when it arrives at the flange, passes from the outside to the inside of the radiating cylinders, and *vice versa*, so that all the air to be warmed passes over about half the distance of the heating cylinder, *e e.* The arrows show the air passing from the inner side to the outside, and from the outside to the inside of the radiating cylinder. In this furnace, it is intended, after the fire is fully ignited that the heat, after rising in the heating cylinder, shall descend all around the fire-pot, as shown by the arrows with two small points. It is often difficult when kindling a fire, to carry off the smoke through a descending flue. A direct flue, *k.*, connects the heating cylinder at the top of the smoke-pipe, *c.* In this last mentioned flue, there is a self-acting damper which closes at a temperature of about 300 deg. The circulation in the smoke-pipe having been established, there is no difficulty in sending off the smoke and gases of combustion through the diving or descending flues. *i i.* represents a circular cast-iron vessel which fits on the outer cylinder as represented in Figs. 7 and 8. *j j.* are the conducting pipes for conveying the warmed air to the apartments.

We will not trouble the reader with a farther description, but refer him to the leading points which we deem so essential in the construc-

tion of an air-warming apparatus. The fire-pot, it will be seen, is so situated that, however high the atmosphere may be raised, the air to be warmed can never come in contact with it; and the heating cylinder is at a sufficient distance from it, to prevent its being affected by contact with the coal in a state of combustion. The amount of heating surface is quite large, and while none of the air can, under any circumstances, come in contact with the fire-pot, the whole air chamber is made practically useful by the action of the equalizing flange. The situation of the water for evaporation we may speak of hereafter.

FIG. 9.

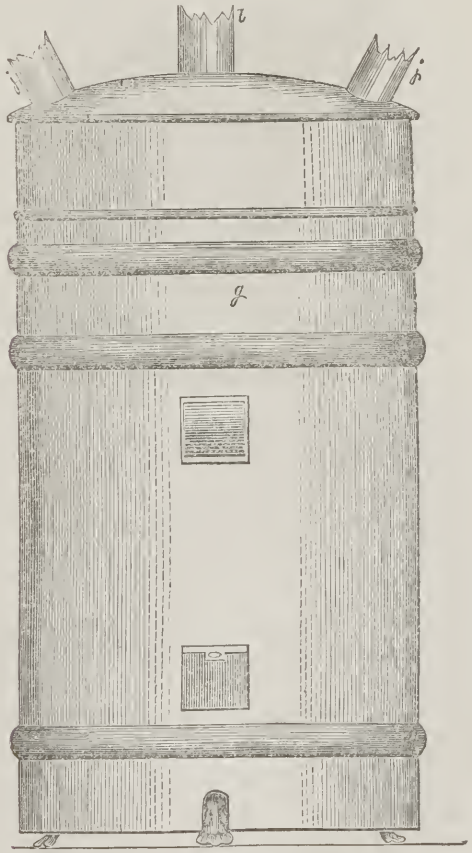


Fig. 9 is a front view of this furnace, set in galvanized iron. Russia-iron is better, when set in a basement-room, used for domestic

purposes. Quite a large number of these furnaces have been introduced among us, and we believe they have given entire satisfaction. Messrs. James Cowles & Co., of this city, are the inventors, and we think they are entitled to the credit of introducing a cheap and philosophical apparatus—free from all the objections which have, with great propriety, been urged against furnaces of this character. It can be enlarged or diminished to meet the wants of almost any family.

Fig. 10.

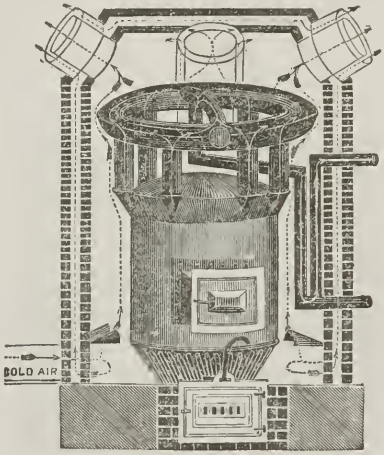


Fig. 10 represents the celebrated furnace invented a few years since, by Gardiner Chilson of Boston. We regret that we have not a series of engravings for illustrating more fully some of the striking peculiarities of this invention; but as we have only the figure before us, we shall proceed to give the reader as full a description as our space and ability will allow.

Mr. Chilson, for this and some other inventions of a similar nature, may justly be considered as one of the best practical inventors in this department of mechanical science. The section of the furnace, here given, shows the air chamber, formed by brick-work which surrounds it. The cold air passes through an opening in the brick-work, and when warmed, rises and goes out in the direction of the black arrows, through the conducting pipes into the apartments to be warmed. The fire-pot is one-third smaller at the bottom, than at the top, and is lined with fire-brick or soap-stone. It is broad and shallow, instead of a *deep* fire-pot and a correspondingly deep fire. When

the combustion is going on, the coal burns with slowbut perfect combustion, and the radiation from the ignited fuel is thrown directly upon the heating cylinder. The position of the pipes at the top is such that the heat is drawn directly to all sides of the cylinder, and continues its course as shown by the direction of the white arrows, into a large cast-iron annular chamber which is connected by a cross-pipe, and from this is carried down near the bottom of the air chamber, and again ascends, as shown in the engraving. The whole radiating surface of the largest size contains about 140 feet, without reference to the smoke-pipe. All the joints and connections are so made, that any expansion or contraction is perfectly harmless; as it is *impossible*, if correctly set, for any of the gases of combustion to escape into the air chamber, unless the castings are broken. This single fact is of great consequence, and as the mode of making these connections is patented, it will be several years before others can avail themselves of the improvement. The greatest point gained by this furnace, consists in the fact, that whether the combustion is slow or rapid, the *whole surface is heated alike.* In *all* the cast-iron furnaces which we have seen, (and we believe we have either seen the castings or drawings of all that have been patented in this country up January, 1851, and all patented in Europe up to 1849); the part nearest the combustion is uniformly at much the highest temperature. In most of them, the fire-pot is often at a white heat, when, by some diving flue, drum, or radiator, the course of the heat is so completely checked, that there is not heat enough in the smoke-pipe to carry off all the heavier gases of combustion. The irregular expansion and contraction, resulting from the unequal distribution of the heat, soon causes the joints to open, and the poisonous gases escape into the air chamber, and unite with the air, often otherwise injured by such a heating apparatus. But it is hardly necessary for us to dwell upon the merits of this useful invention. Others whose opinions would have more weight than our own, have under various circumstances practically tested its merits. Our readers will judge whether our statements and opinions are well founded, while contending that all air-warming furnaces should be so constructed; that *all parts of the heating surface should be heated to the same temperature; that no part of that surface should be raised much above the boiling point of water; and that, under no possible state of circumstances, should any of the gases of combustion, be permitted to escape into the air chamber.*

We know that the community generally will thank us, if we will point them to a furnace which is best calculated to meet their wants; but, without saying more of this particular furnace, we prefer to quote from others. The school committee of Boston, united with a committee from the Board of Aldermen, and used $4,000 in testing the qualities of the various furnaces which had been introduced in New England. The result of their experiments induced the committee to introduce it into the different schools, and this joint committee thus speak of Mr. Chilson's invention. "Your committee have made themselves acquainted, not only with all the furnaces which have been manufactured in this place and its neighborhood; but with all those which have recently been exhibited here. Most of them show much ingenuity of contrivance and excellence of workmanship; but they are all, so far as we can judge, inferior in many respects to the one invented by Mr. Chilson—a model and plan of which we now exhibit and recommend as *superior to all others.*"

Dr. Bell of the McLean Asylum, and author of an excellent essay on the ventilation of public and private buildings, speaks of it, in similar language, and the new addition to this flourishing institution, we understand, is to be warmed by these furnaces. The Gerard College and the higher classes of schools in Philadelphia, have lately sent a committee to Boston to examine and inquire into this whole subject, and we see upon their return home, they recommend the introduction of Mr. Chilson's plan. We need hardly mention the number of premiums it has lately received at different Fairs, for these awards are often made upon such hasty examinations that they are not always *certain* evidence of merit; but when such gentlemen as Professor Norton of Yale College, Professor James D. Dana, and many other scientific gentlemen, who, after a careful examination, and using it in their own dwellings, have written communications, commending it in the strongest terms, those who rely upon others' opinions, will see and feel the force of such authority. In looking over the reports of committees, in favor of this furnace, and the various communications of individuals, we have noticed in addition to the above an array of testimony in its favor sufficient to convince almost any one of its merits; and if our readers are in doubt about our philosophy, we feel quite safe in referring them to the opinions of others. We might add to the list of those who speak from experience, Prof. H. J. Risley, J. T. Headley, Esq., Frederick Emerson, Esq., General John A. Gran-

ger, General E. W. Leavenworth, J. H. Colton, Esq., and many others, who are less known to the public generally.

Mr. A. J. Downing, the distinguished author we have several times alluded to, says, "the best air-warming furnace in this country, so far as our knowledge extends, is one invented by Mr. Chilson, of Boston. We have carefully examined several of the best patterns, and found them all defective from heating the air too hot, while this, (which we have satisfactorily proved in our own residence,) will deliver a large supply of warm air heated to that temperature which warms the rooms agreeably without deteriorating it in quality." We believe Mr. D. is the first writer on architecture in this country, who has in good earnest taken up the subject, and given instructions for warming and ventilating private and public buildings; and although it is about a years since the publication of his views we trust the day, is not far distant, when the great mass of our people will heed his suggestions and profit by his illustrations.

We have endeavored in our suggestions to place the reader in a position where he could judge for himself in the selection of an article of this kind, which is now considered almost indispensable, in order to make a house comfortable during the cold season. We have pointed out what we consider some of the most prominent defects in the construction of the various furnaces which have been introduced in most parts of the country, and have endeavored to show that most of the evils complained of, can be avoided; but there is one point, we have purposely evaded, as we desired to impress our views as strongly as possible upon those who may be influenced by what we may say.

Every one who will take the trouble to read the descriptions of this and that kind of air-warming furnace, will often see it announced, that it has the rare power of warming the air without needing any evaporation in the air chamber. Most persons, experienced in the use of such a furnace, are fully aware that the dryness of the atmosphere is such to use a common expression, that "it tears the furniture all to pieces;" and we will here venture to say, if the inmates of such a dwelling had watched themselves as closely as they did the furniture, some striking injury would have shown itself in one or more members of the family.

No matter how perfect the heating apparatus whether, of steam, hot water, or a furnace, the temperature of which is never raised above the boiling point of water, EVAPORATION is *still indispensable.*

Any one who attempts, when the thermometer is near or below the freezing point, to warm a dwelling by a current of warmed air, and says, evaporation is unnecessary in the air chamber, must be quite ignorant of what constitutes a wholesome atmosphere, or suppose those who listen to him, have the most indefinite notions on the subject. We do not propose to enter into the theory of evaporation, or dwell upon the various causes which in a natural state of the atmosphere increase or diminish it, but simply state the facts which late investigations have settled beyond all controversy. The air at zero is as dry as at 98 deg. in summer, and probably somewhat drier; as there is little or no evaporation from the earth at this low temperature. If, therefore, the air at this temperature (zero) is conducted into an air chamber, and warmed so as to keep the apartments into which it is conducted at 65 deg., without being supplied with the necessary moisture by evaporation, it is exceedingly unwholesome, and will produce serious disturbance upon all the wood-work about the inside of the dwelling. When the air is raised from Zero to 27 deg., its capacity for moisture is doubled, and every 27 deg. thereafter, it is again doubled. The author of almost every kind of air-warming apparatus, has found great difficulty in supplying the air, with the necessary amount of moisture. In some instances, there will be a great excess, and at other times, a great deficiency. One party would complain that the air was too dry, and another that the excessive moisture condensed upon the windows, walls, and ceilings so as to make the rooms exceedingly disagreeable. In this dilemma, the inventor would often come to the sage conclusion, that evaporation was entirely unnecessary, and that the shrinking of the furniture and wood-work of the dwelling was owing entirely to bad construction and unseasoned timber. Late authors have laid down quite a variety of rules for supplying the air with the necessary amount of evaporation; but none of them have taken the pains to apply these rules to an air-warming apparatus. All agree in opinion that when the temperature of the atmosphere is raised, it will absorb moisture from anything and everything, with which it comes in contact, and we know no better plan than that introduced in the portable furnace invented and constructed by Messrs. James Cowles & Co. By a reference to fig. 8, it will be seen that the circular evaporating vessel, *i i*., is so placed that the air, after it is warmed, passes off into the conducting pipes directly over a surface of water. This evaporating vessel is at a sufficient distance

above the heating cylinder to prevent its receiving heat enough, under any circumstances, to boil the water. We deem it to be indispensable, that the location of the evaporating vessel should be at a point where the water never can boil, and at the same time where all the warmed air can pass directly over its surface; and the plan above alluded to, is in our opinion sufficiently correct for all practical purposes.

Although the heating apparatus may be constructed just as it should be, and the air exactly fitted and brought into the apartments, for the most delicate, or the most robust, it can in a very short time be rendered quite unwholesome, nay poisonous, by the respiration and exhalations of the human body. It is impossible to warm a dwelling and have the air *remain* sweet and pure without ventilation. Few persons have any idea of the horrible consequences which result from impure air, and how seriously the duration of human life is affected by the want of proper attention to this subject. Downing says "The greatest possible improvement in a dwelling house—ventilation—is as yet a thing almost unknown in this country."

Dr. James Johnson says, in speaking of the effects of impure air, that "ague and fever, two of the most prominent features of the malarious influence, are *as a drop of water in the ocean*, when compared with the other less obtrusive, but more dangerous maladies that silently disorganize the vital structure of the human fabric, under the influence of this deleterious and invisible poison."

The importance of this subject has awakened so much attention within the last two years, that many of those who have been writing and talking upon it, have been the subject of many a joke from those whose existence depends upon finding something which they can turn into ridicule, for the gratification of that high order of intellectual power which distinguishes them from the rest of mankind. Some of these severe and witty creatures, when in a *serious* mood, declare "there is nothing new in ventilation—that it is as old as fire;" but they seem to forget that prior to the introduction of chimneys in dwelling houses, ventilation was neither thought of, nor needed. Agricola, sometime in the sixteenth century, appears to have been the first writer on artificial ventilation; but for *dwellings* and *public buildings*, it received very little attention until within the last few years, and even now it seems to be almost impossible for the community to understand a subject of such vital importance to the health and happiness of every individual. Many persons suppose the subject is so exceedingly simple,

that any one can attend to it. Architects and builders quite generally speak of it as a matter of no consequence, and if it is desired by any one, they are prepared to attend to it with as much promptness as tho' it were ten fold more simple than they represent. In all such cases that have come under our observation, the whole thing has in some respects, at least, proved a failure. Bernan says that "ventilation is a process so simple in itself, yet withal so delicate, as to be easily impeded or destroyed even by seemingly skilful arrangements to promote it." Dr. Wyman, of Cambridge, one of the best authors who has ever written upon this subject, advises that the ventilation of a building should be committed to no one who does not fully understand the subject. Mr. Hood, Mr. Tredgold, Mr. Richardson, Dr. Reed, and Dr. Arnott, each of whom have written extensively upon the subject, express similar opinions. Some few architects have lately taken up the subject, and we have one among us who has taken much pains not only to inform himself fully, but to introduce it practically among our people.

The disagreement which exists between those who contend that the vitiated air is always at the *bottom* of a room, and those who *insist* upon discharging it at the *highest* point, arises, as we think, from an entire misapprehension of the "known laws which govern the motions of fluids." We listened a few months since, to two very interesting lectures by Henry Ruttan, Esq., of Cobourg. They contained a great deal of useful information and valuable statistics, relating to the consequences upon human life, arising from the present defective mode of ventilating buildings. These lectures were at Minerva Hall —a large and beautiful structure which had been ventilated, under his direction, by the construction of flues or openings at the bottom of the room. We are fully aware that carbonic acid gas, which is so freely generated by respiration and the exhalations from the body, is, when reduced to the temperature of the surrounding atmosphere and after parting with its vapor, heavier than the other gases. It is, however, an *authenticated fact* that respired air, when first thrown from the lungs, is only a small fraction less than five per cent. lighter than the surrounding atmosphere at 65 deg. Fahr. The exhalations of the body, when thrown off in a state of vapor, are still lighter. This important fact, (in which all *late* writers concur,) greatly simplifies the process of spontaneous ventilation, and renders what would, under other circumstances, be *extremely difficult*—equally sim-

ple and certain. Any and all attempts, therefore at ventilation from the bottom of the room, must subject the inmates or a public audience, to the disagreeable effect of using, at least, a part of the air which has been once respired. In order to have the ventilation perfect, it must be direct and constant. The size of the openings to admit fresh air, must be proportioned to the openings for the efflux of the vitiated air. The fresh air should in all cases be introduced at the bottom—the effete air ejected at the top, and no side or contrary currents should be allowed to interfere. We are aware that cold or fresh air, if introduced at or near the top, will, from its own specific gravity, fall directly to the bottom; but the consequences are so well described by Mr. Hood, that we prefer quoting from him to a description of our own. After speaking of the practice of admitting cold air at or near the top, he says:

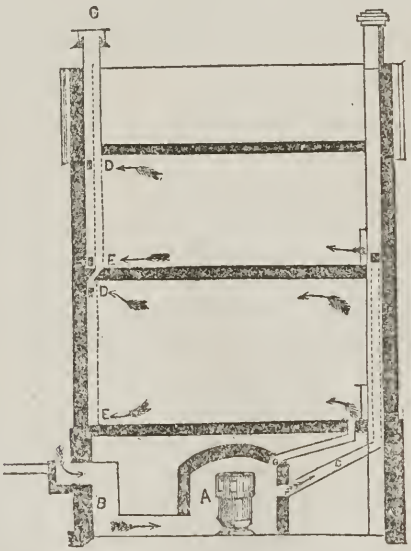
"These effects are frequently very sensibly felt in churches and other buildings, where part of the ventilation is effected by means of windows. The cold air entering at these windows generally descends upon the heads of those who are placed near them. The effect of this entering current is to lower the temperature of the vitiated air, which parts with a portion of its heat to the fresh air entering the building, and the vitiated air being heavier than fresh air of the same temperature, it falls by its specific gravity, and is again breathed by the persons assembled, instead of the pure air which they would have received, had the opening been at or near the floor of the building. No plan of ventilation can be worse than that just described, which, however, is the method adopted in a great majority of the churches, and other large buildings. Notwithstanding this plan has obtained such extensive adoption, it is certain that it is opposed to every sound principle of science, and had its rise in the most perfect ignorance of the physical laws; and no better proof than this needs to be adduced, to show how very little the true principles of ventilation have been studied, and how erroneous any conclusions on this subject are likely to prove that are not based on the known laws which govern the atmosphere."

In *very hot* weather, this mode of ventilation is not *always* sufficient in a crowded assembly to secure a wholesome and comfortable state of the atmosphere. Artificial means have therefore long been used for increasing the natural or spontaneous effect of the plan alluded to. This can be done in various ways. The air in the upper part of the ventilating tube may be heated, or it may be carried to a chimney in any other part of the building, where a furnace or open-fire is burning. All that is necessary is to supply the combustion, and the heated surface from the room or rooms to be ventilated. Frederick Emerson, Esq., of Boston, has, upon strictly scientific principles, invented a kind of top for a ventilating tube, which will, whenever there is a current in the atmosphere outside, greatly assist in spontaneous ventilation. It also protects the tube from the descent of the

storm, and is, in its whole construction and operation, exceedingly simple. We should here present a drawing of the invention, if the reader could, from such an inspection, form any idea of its great utility. It is destined, in our opinion, to become an indispensable article in ventilation, and will be equally sought after for the use of chimneys, which are unfavorably affected by any change of the wind—as soon as its merits are understood. Mr. Emerson is a gentleman who has probably done more to reduce pneumatics to a science, and free it from those never ending exceptions which accompany its general rules, than any gentleman in this country.

During the cold season, when a room is to be raised to the proper temperature, by a current of warmed air, the opening at the top should be closed. The warm air being the lightest, will ascend to the upper part of the building, and if the ventilating flue is not closed there will be a great loss of heat. In all cases, therefore, the venti-duct should have an opening at the bottom of the room also. As the warm air enters the apartment, and seeks the highest point, the colder air falls, and passes up the flue, as shown in figure 11.

Fig. 11.



A, represents the heating apparatus, placed in the basement; *B*, the flue for the admission of cold air; *C*, the conducting pipes, for warmed air. The arrows show the direction of the air. *D*, shows

the opening at the top of the room; and *E*, the lower one; *G*, represents the ventiduct, surmounted by the cap invented by Mr. Emerson. In a private dwelling, the register at the top can, in very cold weather, be kept closed most of the time, but in a public room, or any place where a large number of persons are collected together, as soon as the room is warmed, the upper flue should be opened. An unoccupied public room, with the temperature at 55 deg., will soon run up to 65 deg., when filled with people, without any increase of heat from the furnace. The admission of warm air should be sufficient to supply each individual with at least eight cubic feet per minute; and if the respired air, which at once seeks the upper part of the room, meets with no obstruction, but passes directly out of the building, the air will be just as sweet and pure when the audience leaves, as when they entered.

But we must again check ourselves, and draw our remarks to a conclusion. The subject is so full of interest and importance, that we find it difficult to be as brief as we intended. We should have been glad to have given full directions and drawings for some of the various modes of ventilating public and private buildings, but for reasons which we have stated in our preface. The different modes of warming buildings are so inseparably connected with their ventilation, that neither can be made practical without fully understanding both. The mode of conducting the warmed air to the different apartments—its retention without interfering with its purity—the cooling effect of the glass-windows and various surfaces with which it comes in contact, are each fit and appropriate subjects for a long chapter. Each of these points have been reduced to a system, and the "thousand and one" blunders which have been made, *need not be repeated.* We should also have been glad, if time and space permitted, to have written an article on ship ventilation, the want of which sends annually such vast multitudes of emigrants and others to an untimely grave.

PUBLISHER'S NOTE.

When we commenced the publication of this work, we were greatly pressed with orders, and as soon as the type was set, we were obliged to complete it without further consultation with the author; and no one regrets more than ourselves, the errors which have occurred.

The reader is requested to note the following corrections, which constitute but a part of the result of "too much haste."

Page 4, 21st line from top, after the word "lamp," should be a period.
" 13, line 15, read *examine*, for "examined."
" 25, do 20, " *were it*, do "even if.'
" 35, do 1, " *vertical*, instead of "horizontal."
" 41, do 28, " *attention*, instead of "alteration."
" 42, do 12, " *firred*, instead of "formed."
" 44, do 22, omit the word "he."

HEAT AND VENTILATION.

GENERAL OBSERVATIONS

ON THE

ATMOSPHERE AND ITS ABUSES,

AS CONNECTED WITH THE COMMON OR POPULAR

MODE OF HEATING PUBLIC AND PRIVATE BUILDINGS,

TOGETHER WITH

PRACTICAL SUGGESTIONS UPON THE BEST MODE OF WARMING AND VENTILATING, AS DEVELOPED BY RECENT INVESTIGATION AND IMPROVEMENTS.

ROCHESTER:
D. M. DEWEY, ARCADE HALL.
Press of Daily Adv., Exchange Place.
1851.

WARMING AND VENTILATING

PUBLIC AND PRIVATE

BUILDINGS.

The subscribers after much practical experience and investigation, are now prepared to furnish at wholesale and retail, all the most approved WARM AIR FURNACES and VENTILATING STOVES, which recent investigation, and the most rigid philosophical tests have sanctioned. They have taken unwearied pains to inform themselves upon the various plans which have been adopted in this country and Europe, and trust their improvements will meet the approbation of the community, and give entire satisfaction to all their customers. They are prepared with experienced workmen to fulfil contracts for warming and ventilating PRIVATE DWELLINGS and PUBLIC BUILDINGS, either by STEAM, HOT WATER, or a FURNACE, so constructed that no part of the HEATING SURFACE can, by ordinary means, be raised above the temperature of the steam pipe, or apparatus containing boiling water. They manufacture the celebrated

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